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SIR HENRY MANCE'S ADDRESS.

The English Institution of Electrical Engineers during the past year, it will be remembered, experienced a crisis in its useful career of a quarter of a century, but happily the disorders were eradicated by the exercise of a more liberal spirit in the conduct of its affairs. The body is now carrying out its functions with regularity and without friction, and the members were treated, for the first time in ten years, to a presidential address on Jan. 14 last, on the accession of Sir Henry C. Mance to the presidential chair.

In Sir Henry's address, we notice that he refers to some matters in connection with submarine cable progress which are of general interest. English-like, he seeks to detract from the work of all others but Englishmen in the early struggles of submarine telegraphy. Thus, in his address, he comes to the conclusion, after thorough investigation of the subject, that no one individual can fairly be granted the credit for the inception and development of the submarine cable. If any one more than another deserves especial honor it was the late Sir Charles Tilson Bright, one of the past presidents of the Institution.

According to Sir Henry the monopoly so long enjoyed by England in the manufacture of submarine cables no longer exists. The French have established and well equipped several cable works in French territory, and even Italy is in the field. Since the monopoly has been broken an invitation for American competition would seem to be thus offered. The manipulation of gutta-percha has been the key to the secret so long held by English cable manufacturers, but it is hardly in the nature of things that these jealously guarded secrets can always be withheld from the world. The laying of a cable across the Pacific Ocean is one of the results yet to be accomplished, and when undertaken it should be with an American cable made by an American company backed by American capital.

THE MOST ECONOMICAL SPEED OF A DYNAMO.

The results deduced by Mr. A. G. Hansard in an article on the "Relation Between the Speed and Efficiency of a Dynamo," to be found elsewhere in this issue, are of interest principally for the analytical means employed in obtaining them, but are not to be considered of any particular value to the designer of direct-current shunt machines. The problem is very much similar, and as far as its value is concerned may be likened to Jacobi's law of the maximum output of a motor or to Kelvin's law of the most economical size of a conductor. As with most problems of this nature, either a maximum effect or a maximum economy is obtained when the variables involved are made equal, but there are always such a large number of other conditions, either directly or indirectly depending upon those considered that it is found eventually that the results obtained have little or no practical value Mr. Hansard shows us very neatly that, by making certain permissible assumptions, a dynamo may be operated at its most economical output when the speed is such as to make the total eddy current losses equal to the $I^2 R$ losses.

The conditions of operating shunt machines preclude, however any material change in the speed for the purpose of obtaining any such desirable economy. Similarly, the designer has before him the problem of producing a machine which, running at a certain speed and predetermined voltage, shall give the desired output with the minimum loss, and as it is practically impossible to foretell with any degree of accuracy the probable eddy-current losses, it follows that he can make little or no use of the results which Mr. Hansard

deduces. It is always desirable, and we believe that it is current practice, to design machinery with the idea of making the losses due to various causes each independently a minimum, and even though the eddy-current losses could be predetermined and the design depended upon the three factors of speed, eddy current and I^2R losses in the armature, it would seldom, if ever, be best from the standpoint of commercial practice to run at such speed as to make these two losses equal, or to put on sufficient copper to make the losses equal when running at a given speed. It is interesting to note, however, that the question of dynamo design has not been, apparently, looked upon from the same standpoint as that considered by Mr. Hansard, and now that he has brought up the question it is evident that there are other relations that could be treated in a similar manner.

ELECTRICITY IN FARMING

One of the greatest difficulties that farmers have to contend with is that of securing efficient labor, especially if the farm is a large one, and it is evident that many enterprising agriculturists have asked themselves if electricity does not offer some relief. The subject has been discussed very freely of late in the public and technical press, and is attracting considerable attention on the part of those more or less directly interested. The application of electric power to the operation of farm machines, such as cream separators, churns, threshers, cutters, etc., involves no greater problem than the installation of any simple electric power plant, and many farms in the eastern section of this country and others in Europe are equipped for this purpose. Farmers located near a suburban electric railway line in some cases have tapped off from the same for the purpose of operating such machinery as desired. In one of the recent consular reports it is stated that a farm in Mecklenberg, Germany, is equipped with an electric plant, the power being obtained from a waterfall, and used for operating plows and other farm machinery.

A notable example of the application of electric power to perform farm work is that at Ellerslie, the dairy farm of Hon. Levi P. Morton. Here no expense has been spared to obtain a first-class electrical equipment, with every appliance essential for the successful operation of the establishment. In this case steam power is generated on the premises, and dynamos are supplemented by a storage battery plant which can be used directly for lighting in case of emergency. A description of this interesting plant is given in other columns of this issue.

Another phase of the use of electricity in farming is the application of the electric light in promoting plant growth. Under the influence of the arc-light rays some plants are benefited while on others the effects are not so marked. The forcing of plants and vegetables by the application of the electric light has been performed with most gratifying results. It has been found, however, practicable and profitable only when conducted on a comparatively small scale. The lighting of large areas for this purpose would be so expensive as to render it prohibitive, but for greenhouses and small gardens the influence of the light by effecting the maturity of the plants much sooner than is possible in the ordinary way, could doubtless be made profitable. Another interesting branch of the subject is the application of the electric current to the germination of seeds. This is accomplished in a general way by passing an electric current through the ground between separated electrodes, the seeds to be acted upon being planted in the path of the current. In one experiment it was found that wheat gained about 56 per cent. in weight, while the straw gained only 1 per cent. The use of electricity for agricultural purposes, however, is but in the most incipient stage and can only reach an extended application under gradual development, a more general appreciation of its possibilities and a cheapening of electric power.

SAFETY DEVICES ON ELECTRICAL CIRCUITS.

There has evidently been too great a tendency in the past to make the conditions of testing safety devices conform with existing commercial practice, rather than to attempt to determine under what conditions such devices should be used and their relative merits when properly utilized. This fact is firmly emphasized in considering the several papers and articles which have appeared on safety fuses and magnetic cut-outs within the last three or four years. In a very creditable paper presented before the recent meeting of the Northwestern Electrical Association, an abstract of which appeared in The Electrical World of Jan. 23, Prof. Stine shows that he has carefully considered the subject of safety devices on electrical circuits. In our last issue Prof. Perrine also discussed it from an analytical standpoint, following out the suggestions which were first made, we believe, by Prof. Crocker during the discussion at the Niagara meeting of the American Institute of Electrical Engineers. Notwithstanding the attention which the subject has received there still remain many points which are open to question, especially on the relative merits of fuses and automatic mechanical devices under different conditions. Both fuses and mechanical devices have their uses, but it is perhaps difficult to say where the dividing line should be drawn. If we were to accept Prof. Stine's view the mechanical devices would be used in almost every case, while others have advocated a more extended use of the fuse. As was pointed out by Prof. Perrine, and in fact it is almost self-evident, it is possible to design a fuse which will adequately protect the circuit on which it is placed. A wire of definite cross section, length and specific heat and having a definite temperature of fusion, will, when placed in a receptacle of definite dimensions with proper protection from air currents, fuse within a definite time when carrying a current of definite amount. These conditions can readily be made standard, so that the different services for which a fuse is designed to perform could be knowingly met with.

Notwithstanding the fact that fuses have been in continued and are still in successful operation, it cannot be questioned that the adoption of a standard form of fuse and receptacle designed for the particular conditions under which it is to be used will result in better practice and a material decrease in insurance risks. The magnetic circuit-breaker undoubtedly has many valuable properties, and this fact is fully demonstrated by the rapidly extended use with which it is meeting. It does not follow, however, that it more satisfactorily performs in all cases the functions for which it is installed than would a fuse properly designed and acting under the same conditions. As a fuse is never used for the purpose of protecting a lamp from an excess of voltage there is practically no case in actual practice in which it is desirable to have it melt when subjected to short excessive current fluctuations due to variations in voltage, the extraordinary demands of a motor load or other causes, but on the other hand, it is highly desirable that it should be able to carry any current which the conductor it is designed to protect will carry without undue heating and consequent impairment of the insulation. It does not matter, therefore, whether the conductor is connected to lamps or motors, the fuse should bear to it a definite relation. For these reasons it is not evident why, as Prof. Stine has maintained, motors should be invariably protected by a mechanical device in preference to a fuse. It can readily be seen, however, that a mechanical circuit-breaker constructed so as to have a time factor equivalent to that of the proper fuse could be made to fulfill the same functions as the latter. Such a device would answer all the purposes of a fuse, and although more costly to construct, would possess the advantage of being easily and quickly reset and would obviate the faults which are inherent in a fuse and which develop with continued use. Until, however, such a device has been perfected, the fluctuating demands for current in motor service can only be most effectually met by a properly designed fuse and receptacle.

Some Dielectrics and Their Insulating Properties.

BY GEORGE T. HANCHETT.

The writer's experience with the construction of induction coils has led him to observe the dielectric strength of many of the commercial insulating substances which are noted for their power of resisting the disruptive influences of the electrostatic discharge.

Mr. C. P. Steinmetz and others have contributed valuable data on this important subject, and have reduced the measurement of the dielectric strength of insulators to the application of simple formulas. Inasmuch as in practice there are many notable exceptions to the results given by these formulas, due to flaws or to slow deterioration of the insulating substances, the writer has presumed to believe that a few remarks on these practical considerations may be of interest.

Hard rubber is perhaps one of the most reliable solid dielectrics that we have, and when pure is notably effective in resisting great differences of potential. Unfortunately it is quite difficult to get a piece that is pure and the little particles of foreign material that commercial rubber contains seriously reduce its efficiency as an insulator.

When a sheet of hard rubber is exposed to a high potential difference and the dimensions of the sheet are such that the discharge cannot leap around it, a powerful brush discharge issues from both terminals and streams against the surface of the rubber. Every particle of the impurities within range becomes oppositely charged by induction, and assists in maintaining the brush discharge. The latter seems to have a deteriorating effect on the rubber for as the experiment continues the discharge strengthens and the streamers become less and less attenuated till suddenly rupture takes place and the streamers gather into a single calorific spark which strikes through the hole that has been penetrated. This action is fully as gradual and deliberate as the slow puncture of a stretched membrane by some sharp instrument. The material gradually weakens and finally gives way.

Glass, on the other hand, acts in a different manner. Streaming discharges take place upon it, it is true, but instead of weakening the glass they simply feed the leakage currents flowing over its surface. Not until the dielectric strength of the glass is exceeded does puncture take place. If the glass is not actually punctured it will not be injured by such treatment, but such is not the case with hard rubber. A crude mechanical analogy illustrating this difference in penetration is shown in the punch and the drill. Electricity punches a hole in glass; it drills one in hard rubber.

FIG. 1.—PUNCTURE THROUGH GLASS.

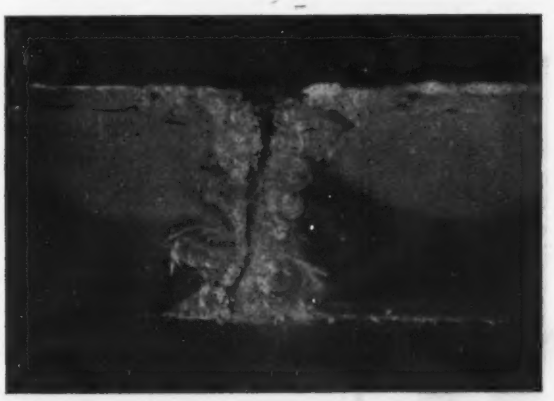


FIG. 2.—SECTIONAL VIEW OF A PUNCTURE THROUGH GLASS.

The E. M. F. of an induction coil is a fluctuating one and even the maximum values vary according to the action of the vibrator. When the potential is such that the gnawing action referred to takes place on a sheet of hard rubber, the puncturing potential of glass of equal thickness is usually exceeded and thus the two dielectrics are almost equal. They have each distinctive advantages. The glass has the great advantage of maintaining its quality against electrical stresses and the natural deteriorating effects of age, but it has the fatal objection of being too brittle. For partitions between sections in an induction coil it will answer, but it is inadequate to withstand the mechanical stresses imposed on the primary envelope. Hard rubber on the other hand admirably withstands mechanical stresses and if not subjected to voltages that slowly deteriorate it is in every way preferable. A coil that is insulated with glass, but insufficiently, will break down at once. One insufficiently insulated with rubber will endure for a time, and will finally break down. This interval is utilized by unreliable makers as one in which to sell the coil.

The puncture made in glass by the electrostatic discharge is interesting to examine because it is exactly as the puncturing stroke has left it. With hard rubber, the hole is usually melted round by the spark that follows, but glass seems to be able to withstand this heating in most cases. Fig. 1 shows a microscopic enlargement of a puncture through glass. It will be observed that it has the appearance of a tunnel chiseled out with numerous strokes and that there are no fractures that extend to any distance or completely through the glass. It seems as though the glass had been cracked into small pieces and removed. A bullet hole in glass differs by showing fractures that extend completely through the thickness of the sheet, and the appearance just noted in electrical puncture may have a significance. Glass broken down electrically certainly does not receive a single punch. The action seems to take place simultaneously throughout the length of the hole and tear the particles apart.

A sectional view of the puncture shown in Fig. 2 reveals the fact that the hole is crooked and still further verifies the conclusion that it is not due to a mechanical stress exerted suddenly in one direction for the hole resulting from such action would be straight. The chiseled appearance of the aperture is still more plainly marked in this illustration. The glass was carefully cut to divide the hole, and great pains were taken not to injure the hole with the glass cutter. Nevertheless some little places near the edge of the hole were slightly scaled by the crack that divided it. It will be noted that the hole has a funnel-shaped enlargement at either end, but such a formation might easily be due to scaling of the glass due to the heat of the spark.

Fig. 3 illustrates another interesting puncture, if such it can be called, of a glass plate. The space actually punctured was occupied by a combination of glass and paraffine, and the discharge ran along the joint between them and actually chiseled out a groove in the glass, in preference to grooving the paraffine. Of course, the latter was melted somewhat by the discharge and its exact initial condition could not be observed. The potential that punctured the hole shown in Fig. 1 was due to two sections of an induction-coi capable of striking three inches of air, but the grooving discharge of Fig. 2 was due to the potential of a few layers only. The latter has some significance, for it demonstrates the fact that even the best of joints are to be avoided in the insulation of an induction-coil, as the comparatively low potential of a secondary layer is sufficient to break through them.

It is interesting to note that the grooves are forked and sinuous in much the same way as the path of a discharge in free air, and further that along their length they are serrated at very nearly equal intervals, as though the grooves were effected by a series of equally timed blows. Indeed the latter may be the case as the E. M. F. was pulsatory, and if that is true, we need only count the serration and divide their number by the speed of the vibrator at the time to obtain the actual time interval employed in grooving the glass. It would be interesting to compare such grooving with some similarly made by means of an influence machine.

Paraffine is an insulator that is very important in the construction of induction coils, and it is quite effective in some places. It has, however, some serious practical faults, one of which is not generally known.

Among the most annoying and first noticed trouble is the diffi-

culty of solidifying paraffine in such a way that it will be free from air bubbles.

In places where one half inch or more of solid paraffine should exist the effective thickness may be reduced to less than one eighth of an inch by a string of air bubbles. The sheet of insulating material is no stronger than its weakest part and thus five or six air bubbles may render 20 pounds of paraffine insulation worthless. Paraffine should never be relied upon as a support for any heavy weight, such as a secondary section in an induction coil. In warm weather it becomes viscous and will allow the coils so supported to change their position and the insulation between localities between which a high potential exists may be so far shortened that it will break down.

When paraffine is punctured it is blackened and carbonized by the subsequent discharge and has a peculiar and unmistakable odor. The writer when examining the paraffine surrounding the terminals of a large induction coil recently noted a remarkable blackening accompanied by the odor just referred to. No evidences of direct puncture were present but the paraffine was slowly carbonizing under the effects of surface leakage and brush discharge, and the fault was spreading. This behooves the makers of paraffine induction coils to keep that material away from the terminals and to surround the latter with a more enduring material, such as glass or hard rubber.

Parrafine oil is a much used and very effective insulator, but it has notable disadvantages with high potentials. If punctured an oil insulator will mend itself and it can be repeatedly punctured without seriously deteriorating. It has, however, a disadvantage that does not reduce its dielectric strength, but materially reduces its efficiency as an insulator. It is a flexible fluid and is subject to convection discharges. The particles of oil become charged by contact with highly charged surfaces and are repelled to oppositely charged surfaces where they discharge and come back for more. Wherever currents of high potential are to be insulated and these potentials are such that a single condition of charge obtains for the greater part of the time, this convection will take place and often to the serious detriment of the working of the apparatus. This statement is substantiated by the following interesting experimental verification:

On immersing two highly charged terminals in oil and placing them near each other the surface of the oil is greatly disturbed, and from its very appearance suggests the flow of convection currents.

Fig. 3.—Surface Fissure on Glass.

If a light fragment of paper or some equivalent substance is dropped on the surface of the oil between the terminals it vibrates back and forth between the terminals in precisely the same way an oil particle is supposed to do. Analogous experiments have for some time past been performed in courses in elementary physics. When the terminals are raised from the oil dripping, the oil streams from terminal to terminal in fine threads, showing conclusively that the oil is a carrier of charge, dielectric though it be.

As the use of Röntgen-ray apparatus becomes more general and the induction coil becomes a commercial instrument which is required to operate for long periods of time, the need of two new insulating substances will become more pressing. One must be an easily melted material that will cool in a mould without blow-holes or flakes, and the other must be a rigid, solid substance suitable to support and enclose high-potential coils. Above all these insulators must endure against mechanical and electrical stresses and they must be cheap and easy to work.

The Gas Exposition at Madison Square Garden, New York City.

It is hardly to be expected that an electrically inclined visitor to the Gas Exposition being held at Madison Square Garden, New York City, would find very much more of interest than a somewhat varied collection of gas generating, heating and power appliances. The intent seems to have been to entirely eliminate all evidence of that more than successful rival, electricity. How successful the substitution of gas for electricity has been in the general illumination and decoration of the Garden is a matter which leaves but very little to the imagination of those who are familiar with the possibilities of both. A few electrical appliances seem to have gotten into the exhibit, and these in connection with the several gas engines exhibited may be of interest.

The Progressive Age shows a small thermopile at its booth. Gas in the form of a Bunsen flame is used to heat a number of metallic couples joined in series, and the current generated at about one and a half to two volts is supplied to a six-inch fan motor.

The Connolly Iron Sponge & Governor Company has on exhibition the Schmidt electric gas lighter. This device is an automatic gas burner operated by a single electromagnet and circuit. The magnet controls the gas valve by means of a catch pawl, which alternately opens or closes the valve, and also operates the spark contacts. A single button is used. Aside from this, and the ingenious latch in the burner, the apparatus is similar to ordinary automatic burners in general use.

A Fort Wayne Electric Corporation multipolar dynamo is shown in conjunction with a New Era horizontal gas engine. The dynamo is belted to the engine and is controlled from a small switchboard, equipped with main and feeder switches, ammeter, voltmeter and field rheostat. Current is supplied to some lights on one of the towers.

The New Era gas engines are built in various sizes, from 4 to 60 horse-power, by the New Era Iron Works Company, Dayton, O. They are of the four-cycle type, using a make-and-break spark ignition, and are regulated by a separate centrifugal ball governor, run from the lateral valve operating the shaft which controls the admission of gas to the cylinder. Tube ignition is also used in some cases.

When gasoline is used as fuel a special vaporizing apparatus, to which the gasoline is pumped, is used in connection with the engines. On larger engines a hand-pump starting apparatus is used. By this device the engine is started by compressed air.

Fairbanks, Morse & Co., Chicago, Ill., exhibit one of their well-known horizontal gas engines. These engines are of the four-cycle type. The charge is ignited by a contact spark in the cylinder, although tube ignition is also used. The engine is regulated by a fly-wheel governor controlling the gas supply and also the exhaust valve so as to relieve the engine from unnecessary compression. The starting apparatus consists of a small hand pump, which is used to compress a charge of gas in the engine cylinder, which is ignited by a separate sparking device operated by hand. These engines are notable for their heavy and solid construction necessitated by the adoption of a long stroke, large piston area and slow speed.

A small horizontal gas engine is shown in operation by August Meitz, 128, 130, 132 Mott Street, New York City. The engine is of the two-cycle type, uses an incandescent tube igniter and is controlled by a governor on the main shaft.

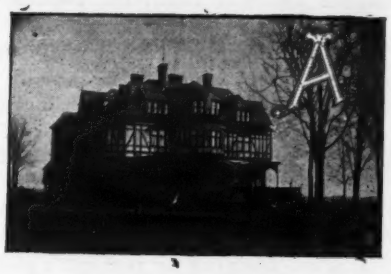
The American Motor Company, Havemeyer Building, New York City, shows a number of small gas and gasoline engines. These engines are mounted vertically in small sizes. The larger engines are horizontal. They operate on the two-cycle plan, using a contact-spark ignition. All valves are cast on the cylinder head, eliminating thereby all packings, bolts, etc. The governor is in the fly wheel of the engine and controls the exhaust valve. All valves are of the poppet type. The company is about to place on the market engines ranging from one to one hundred horse-power.

Inquiry among various gas engine exhibitors showed a general claim of from 17 to 20 cubic feet of ordinary gas per horse-power hour.

British West Indies Cable.

A London despatch announces that negotiations are in progress in England for the construction of a British West Indies cable. This line will be operated in competition with the French-American cable recently opened.

Electricity on a Farm.



FULLY equipped electric light and power plant on a farm is a distinct novelty, but in the case of Ellerslie, the model dairy-farm of former Vice-President Levi P. Morton, the utility and advantages of electricity in farm and dairy operations have been illustrated in a very complete way—one that is of interest also as showing the adaptability of electrical methods for many different varieties of work.

The farm buildings of Ellerslie lie upon the summit of one of the rolling hills of Dutchess County, about two miles from Rhinecliff, N. Y., and about 90 miles north of New York City. Grouped around a central yard about a quarter of a mile from the residence are barns, cow-stables, offices, dairy buildings, dwellings for the farm hands, and the power house, from which electric power and light are distributed.

The power plant is installed in a handsome brick building, which is substantially finished inside in hard wood and tiles and provided with a brick stack. The boilers are two in number, a Watertown 80 horse-power supplying all the steam ordinarily needed, while a Williams & Potter 40-hp boiler is used as a reserve and in cases of emergencies and repairs. Live steam from these boilers is piped to a 20-hp engine in the large barn and to a 10-hp engine in the nearby dairy building, where it is also necessary for use in daily sterilizing the various articles coming in contact with the milk, as well as the interior of the building, which is subjected frequently to this process.

The electric plant in the power-house consists of two C & C dynamos of 12.5 and 25 kilowatts respectively belted directly to a straight line engine of 35 horse-power. The two generators are mounted on a large brick pier, covered with porcelain tiles, their leads being conveyed to the switchboard through brass-armored conduit.

The smaller of the two dynamos operates, at 500 volts, the power circuit described below. The larger, working at 110 volts, is used for charging a large storage battery, or in an emergency may be used directly in connection with the lighting circuits.

The battery consists of 67 of the Electric Storage Battery Company's cells, of 720 ampere-hours' capacity each. A combination of Manchester positive plates with chloride negative plates is found to give excellent results in these cells. The battery is installed in a room having brick walls and a cement floor with the usual contrivances for drainage, etc., and is contained in a simple arrangement of racks, permitting easy access to each cell.

Twenty-one of the cells are controlled by large circular point-

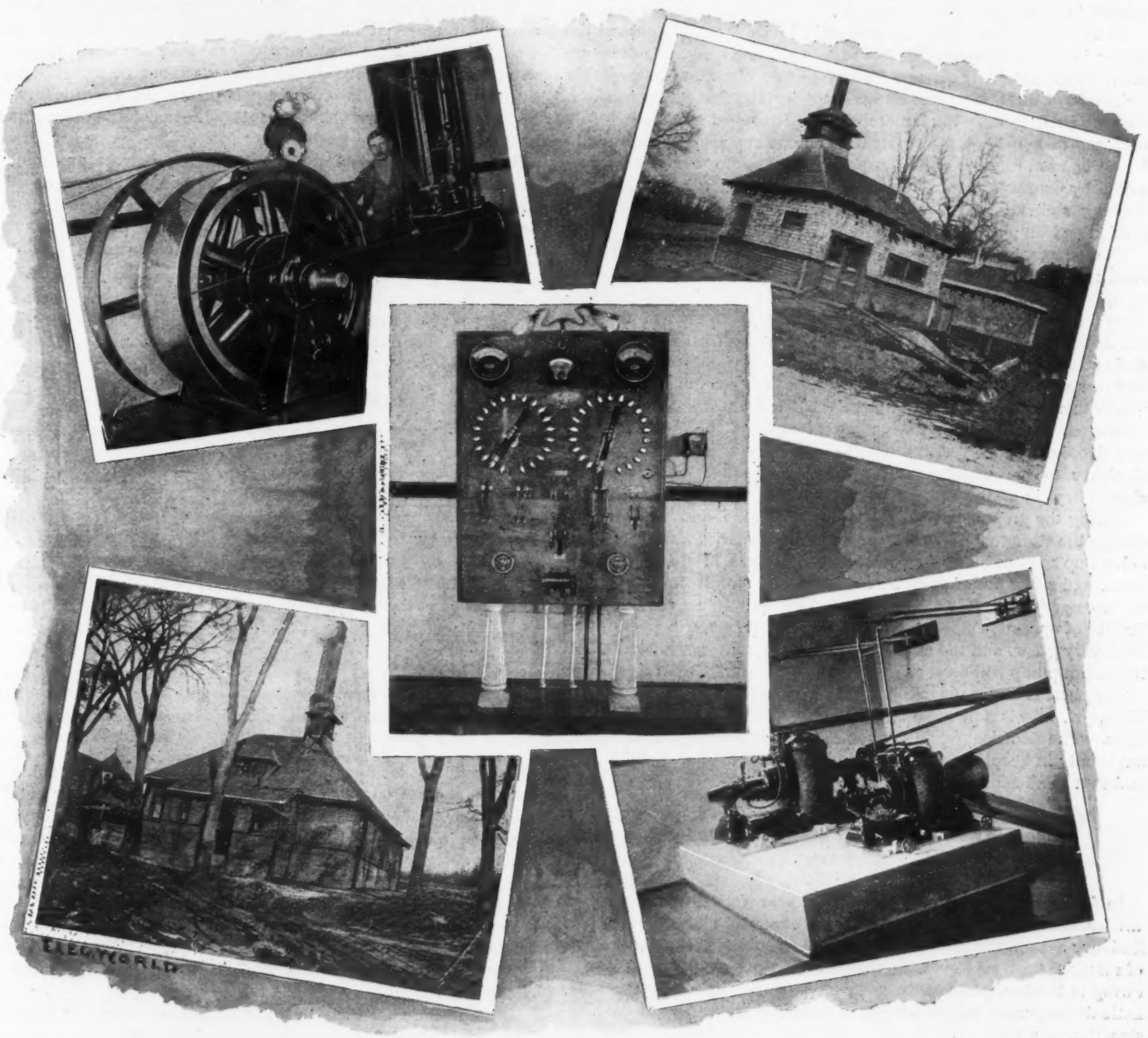


FIG. 1.—TYPE OF ENGINE.

FIG. 2.—POWER-HOUSE.

FIG. 3.—SWITCHBOARD.

FIG. 4.—PUMP HOUSE.

FIG. 5.—DYNAMOS.

switches on the main switchboard and can be variously combined with the main battery for voltage regulation.

The principal feeder line for lights is a pair of lead-covered cables of 450,000 circular mils each, laid underground for nearly 1300 feet to the residence. Other lines are carried from house to house among the farm buildings, 258 lamps in all being supplied.

The power circuit is about 1500 feet in length and include three motors, all of which are used for pumping water. The first is an Otis Electric Company's 10-horse power elevator type, situated about 700 feet from the station. It is geared, by a double reduction, to a pair of Worthington plunger pumps which deliver water from a well to a tower on a hill top, 1500 feet away, under a pressure of nearly 100 pounds per square inch. This tower is the general reservoir of the water distribution system of the farm, and furnishes a sufficient head at the power plant to feed the boilers directly against the steam pressure.

The water supply for the residence is in duplicate, two small electric pumps being arranged to furnish water from different sources. They consist of Lundell motors of one horse-power each, geared to small Worthington pumps.

At all the electric pumps an automatic device is used to cut out the motor in case of stoppage of the supply current. By this arrangement when current is thrown on the power circuit from the main switchboard there is no danger of suddenly starting the motors and blowing their fuses. Each motor pump is installed in a house of its own, the 10 horse-power combination having replaced a steam pump formerly used for the same purpose. The pump stations are protected by Garton-Daniels lightning arresters, and C & C automatic starting switches are used with each motor. The power circuit is carried on iron poles throughout its length.

The barn, which shelters the largest and most valuable herd of Guernsey cattle in the world, is correspondingly the most completely equipped and largest structure of its kind. It contains accommodations for more than 300 cows, and is most elaborately arranged for the comfort and health of the cattle as well as for the convenience of their attendants. It is lighted with incandescent lamps throughout, and contains 250 fire-alarm thermostats, or over six miles of circuits. These thermostats, installed by the Electric Heat Alarm Company, of Boston, are arranged to ring alarm bells in the men's working and sleeping quarters and elsewhere about the farm in case of fire. Contrary to the usual practice, they are frequently tested, and always kept in a high state of efficiency.

During the greater part of the year it is not found necessary to charge the storage battery oftener than once or twice a week. Steam is kept up constantly at the power house, for use in the dairy processes, and a few hours' operation of the power circuit daily supplies the necessary water for all purposes. The gain in convenience and facility of operation since the installation of the electric pumps has been very great, and the saving in coal over that formerly used by the steam pump will soon pay for the new pumping apparatus.

The plant is under the skillful management of Mr. Charles Van Wert, Jr., who is now making preparations for a number of extentions. The electrical equipment at Ellerslie is thorough and unique, but is only in keeping with the general perfection of detail which makes it in all senses a model farm.

Economy in the Design of Electromagnets.

BY W. E. GOLDSBOROUGH.

In designing an electromagnet to perform work by attracting an armature over an air-gap, we must of necessity make certain preliminary assumptions, and I wish to call attention to the great waste of material that may exist in magnets of presumably good design owing to the limited knowledge we have of the relation of the magnetic density used to the weight of material necessary to the construction of a magnet.

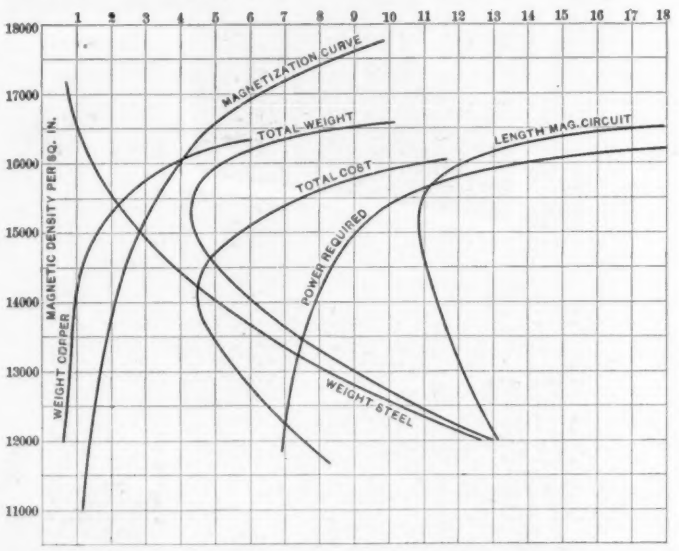
It can be readily proved mathematically[1] that to give the best results the ratio of the rate of change of the magnetic flux in the iron to the rate of change of the magnetizing force producing it must be equal to the permeance of the working air-gaps. This condition only exists when the armature is at one definite distance from the poles and at this range the magnet will perform the greatest amount of work; where work is defined as the product of the initial pull times the travel of the armature.

In designing an electromagnet to perform a given number of inch-pounds of work, this condition should be met before other modifications tending to greater economy are introduced. Since, however, by properly adjusting the length of the magnetic circuit in the iron, it is possible to design a magnet that will fulfill the conditions above mentioned and use any magnetic density in the iron it becomes at once apparent that the magnetic density employed has a marked influence upon the weight of material required.

Owing to the varying permeability of iron and steel at different magnetic densities, a rather complicated relation exists between the various quantities involved. In any given case, however, the weight of magnetic material decreases with the increase of the magnetic density, however high it is carried, while the amount of copper required for the exciting windings correspondingly increases with the magnetic density. In a magnet designed to perform a given number of inch-pounds of work the cross-section of the iron core will be the smaller, the greater the magnetic density used, but the travel of the armature or the length of the working air-gaps will increase with the magnetic density. In general it is best to use high magnetic densities where the travel of the armature has to be large, and low magnetic densities when the necessary travel is small.

As a matter of fact, there is but one magnet that can be made with any given material and for definite duty that will have the least weight or the least cost, as the case may be; and if the range of action of the armature of this magnet cannot be suitably adjusted by modifying the shape of the pole-pieces, the use of levers should be resorted to, as any change in the dimensions of the magnet will lessen the economy of its design.

To illustrate the importance of making correct preliminary assumptions I have prepared a plate of curves, which are based upon a series of designs of electromagnets to perform 100 inch-pounds of work. The results embrace variations in the magnetic density of from 12,000 to 17,000 gausses. The cores are made of a



FACTORS IN THE DESIGN OF ELECTROMAGNETS.

high grade of cast steel, and the coils are made of double cotton covered magnet wire. A uniform variation exists in the outside dimensions of the magnets, which are of the horseshoe type, and the same allowances are made for insulation. The magnets are further designed to work at the some temperature, and are as nearly comparable as a set of designs of such widely different dimensions can be made.

Furthermore, as the designs are all of the same type the cost of the labor of constructing any one of them may be regarded as practically the same. They only vary in the cost of the materials of construction.

In this particular case the lightest magnet weighs 44 pounds, and has an initial density of 15,400 gausses in its core. Varying the magnetic density only a few per cent. on either side of this value will double the weight of the magnet. In the same way there is a particular density at which the cost of the materials of construction is a minimum. This occurs at 14,100 gausses. The cost-curve has almost the same shape as the weight-curve, and its position depends upon the relative value of copper wire and steel.

The lightest magnet costs 57 per cent. more than the cheapest, and the cheapest weighs 30 per cent. more than the lightest. The lightest magnet is, of course, the smallest and has the shortest magnetic circuit.

Above the density of minimum weight the copper increases so

[1] E. R. Carichoff, THE ELECTRICAL WORLD, Jan. 27, 1894.

fast—and below the point of minimum weight the steel increases so fast—that the total weights of the magnets rapidly increase on either side of this point.

The electrical energy required to operate the magnets increases with the magnetic density, although only slowly until the point of least weight is reached, after that it increases very rapidly, owing to the rapid increase in the copper.

The example just cited may be taken as a guide in designing magnets for other capacities, as the same modifications exist in all cases; they only vary in degree.

Summing up, my experience leads me to believe that the best results are to be obtained by working just below rather than just above the knee of the magnetism curve, although the latter is the more usual practice.

Principles of Electrical Distribution.—VIII.

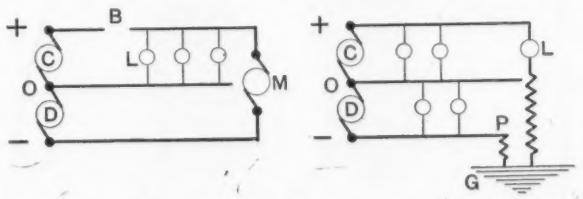
BY FRANCIS B. CROCKER.

LAYING AND OPERATING THREE-WIRE SYSTEMS.

THE general arrangement of three-wire feeders and mains may be made substantially the same as already described for the two-wire system, the same methods and care being used in regulating the voltage. The feeders may consist of three conductors of the same size, but usually the neutral wire is made one half as large as either of the others, and if storage batteries or equalizing machines are placed at the outer ends of the feeders, the neutral conductor may be omitted, as previously explained on page 168. For the mains and leads the three wires are generally made the same size. The important point in connection with the three-wire system is the necessity for carefully *balancing* it; that is, keeping the currents on the two sides approximately equal. To accomplish this, the lamps and other devices requiring current are divided between the two sides of the system so that the loads shall be as nearly as possible the same for full capacity or any fraction of it. For this reason all three wires should be carried to any point where energy is required unless the amount is extremely small. This applies to every building even though it contains only a few lamps, and in fact, to almost every room that is to be supplied with current. In this way the chance of having any considerable difference in load is reduced to a minimum.

Nevertheless, it is possible that a great many lamps might happen to be lighted on one side of the system and very few on the other side, in which case the drop in voltage would have about twice its normal value for the larger number of lamps, while the pressure might be raised for the smaller number, as already explained (Fig. 22). The likelihood of this happening is small, however, particularly in large systems, provided the lamps are carefully divided in wiring them. In case many lamps are to be lighted at the same time, they should be controlled by three-pole switches, which connect them to the two sides equally, or they should be divided into groups which are thrown on the sides alternately.

Grounding the Neutral Conductor.—A question that has aroused much discussion is the advisability of purposely grounding the neutral conductor of a three-wire system. The two principal



FIGS. 30 AND 31.—PECULIAR CONDITIONS ON THREE-WIRE SYSTEM.

arguments in favor of this plan are: First, it practically limits the potential between any wire and the earth to about 110 volts. Second, it greatly reduces the drop on the neutral conductor since the current can also flow through the earth. In regard to the first of these reasons, it is a fact that the potential of the positive wire may rise to 220 volts if the negative wire becomes grounded, or *vice versa*, when the neutral wire is insulated. But it can hardly be said than trouble would be avoided if the neutral were grounded, as the effect of a ground on either of the other sides would then be to make a short circuit which would blow the fuse of that wire, and perhaps that of the neutral also, thus putting out the lamps on that portion of the circuit. To be sure this locates the trouble and calls for immediate attention, which may be a simple, but is also a crude, way to keep the circuits clear of faults. If an accidental ground connection exists on one of the conductors when the neutral wire is not grounded, no trouble results until another ground occurs on one of the other two conductors. In the mean time an opportunity is afforded to correct the fault before any interruption of service or difficulty of any kind is experienced.

Unfortunately it is very troublesome to detect and locate a ground connection even on a two-wire circuit and still more so with three-wires. Nevertheless there are methods which the writer knows from actual test on a very large system will accomplish this result, and if these were more generally used they would be found to afford thoroughly practical and convenient means of taking care of three-

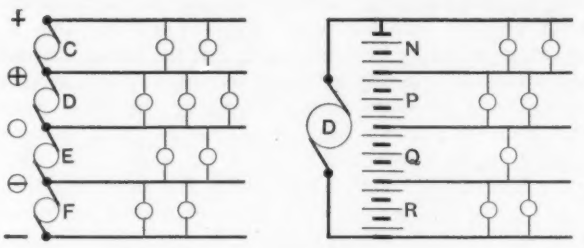


FIG. 32 AND 33.—FIVE-WIRE SYSTEMS.

wire systems. But these methods fail; in fact the problem is practically impossible to solve if the neutral wire is grounded.

Regarding the second advantage of grounding the neutral conductor, it may be said that it is well enough to use the earth to reinforce the conductance of the circuit, provided no serious difficulty results. But it is found that great damage is done by electrolytic action on gas, water and other kinds of pipes if large currents are allowed to flow promiscuously through the earth. In the case of electric railways with overhead trolleys it is necessary to allow the current to pass into the track or else adopt the double-trolley system, which is complicated and not considered practicable. But even for the trolley system the tendency is to demand more perfect bonding of the rails, and the use of return feeders to reduce the stray currents. For electric lighting no very strong reason exists for intentionally grounding the circuit or any portion of it, except perhaps the secondary circuit of a transformer, as a safeguard in case the high-tension primary circuit accidentally connects with the secondary.

Insurance and fire department authorities are vigorously opposed to grounding the neutral of a three-wire system, or, in fact, any part of an electrical circuit, their experience having convinced them that it is the source of much danger and trouble. It is because of this opposition that the practice has been abandoned or avoided as far as possible, as central station officers would much prefer to ground the neutral conductors.

Peculiar Conditions on a Three-wire System.—The following cases may occur:

1. The dynamo or dynamos on one side of the system may be accidentally reversed, so that both of the outside wires are positive or both negative. In that case a motor or other device fed by the two outside conductors will receive no current, but lamps, etc., connected between the neutral and either of the outside wires will act as usual.

2. If one of the outside wires is open at *B*, Fig. 30, due to the blowing of a fuse or other cause, a motor *M* (220-volt) beyond the break, *B*, will receive some current at 110 volts through any lamps, *L*, that may be on the same side of the break as the motor, and on the same side of the system as the break. These lamps will light up when the motor is connected, but the latter will have little power.

3. If the neutral wire is open a motor or other device connected to the outside wires will act as usual, but lamps on one side of the system will burn more brightly than those on the other side, unless the two sides are exactly balanced.

4. If one of the outside wires, Fig. 31, becomes grounded at *P*, a 110-volt lamp, *L*, or other apparatus, also grounded and connected to the other outside wire, will receive 220 volts, which might injure it.

FIVE-WIRE SYSTEMS.

The principle of the three-wire system may be extended, in order to effect a still greater saving of copper in electrical distribution. It would be possible, for example, to have a four-wire system requiring two ninths as much copper as an equivalent two-wire circuit, but, for reasons to be given later, it has rarely if ever been tried. The five-wire system is employed in many places in Europe, but has not been introduced to any extent in this country. It may be

operated with four dynamos, *C*, *D*, *E*, and *F*, as represented in Fig. 32, but the arrangements shown in Figs. 33 and 34 are more common. The second of these is similar to the three-wire system illustrated in Fig. 29, only one main dynamo, *D*, being required, and the total pressure generated by it, ordinarily about 440 volts, is subdivided by the four small equalizing machines, *J*, *K*, *L* and *M*. These may consist of four separate machines mechanically connected together, or they may be made with all of their armature windings upon the same core and acted upon by one field-magnet, in order to neutralize the effects of armature reaction. Fig. 33 shows a combination similar to the three-wire system represented in Fig. 25, a battery, *N*, *P*, *Q*, *R*, being utilized to subdivide the voltage of the main dynamo *D*.

The comparative weight of copper required for the five-wire system may be determined by reasoning similar to that used in connection with the three-wire diagrams, Figs. 23 and 24. But it can be arrived at more simply by considering that the current in each of the outside wires of a perfectly balanced five-wire system is one quarter as much as in a two-wire circuit supplying the same number of lamps. Hence the drop is only one quarter as great in the former case, assuming the conductors to be of the same size. But since there are four sets of lamps in series with five wires, the *percentage* of drop is $\frac{1}{4}\times\frac{1}{4}=\frac{1}{16}$ as much, or in other words, each conductor need be only one sixteenth as large for the same percentage of drop. Therefore the two outside conductors of a five-wire system weigh one sixteenth as much as those of an equivalent two-wire circuit and the five conductors weigh $\frac{2}{16}\times\frac{5}{2}=\frac{5}{8}$ as much if all are made of the same size. By making each of the three intermediate wires one half as large as each of the outside ones, the total weight is reduced to $\frac{1}{16}+\frac{3}{8}\times\frac{1}{32}=\frac{7}{64}$, or less than one eighth as much copper as the two-wire circuit demands. The various results that have been obtained may be recapitulated as follows:

Comparative weights of copper required, ordinary two-wire circuit :

Three-wire system, all three wires of same size	0.375
Three-wire system, neutral, one half size	0.313
Four-wire system, all four wires of same size	0.222
Five-wire system, " five " " " "	0.156
Five-wire system, three inside wires one half size	.109

It is evident that similar systems having a greater number of wires might be designed, but they would be extremely complicated and of very doubtful advantage. In fact, the desirability of a five-wire system is questionable, since the use of 220-volt lamps enables three-wire circuits to be operated at 440 volts. A five-wire system calls for an even more perfect balance of load than is needed for three-wire circuits. This is secured by carefully dividing the lamps, etc., between the four parts of the

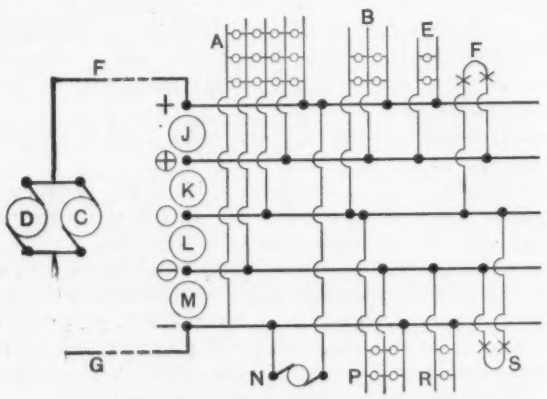


Fig. 34.—Five-Wire System.

system so that the loads may be as nearly equal as possible at all times. To this end all five wires should be carried wherever any considerable amount of energy is likely to be used, as represented at *A* in Fig, 34. If the demand for current is small it is only necessary to run three wires, as shown at *B*. But in this case an equal load *P* should be connected to the other side of the system. For very small loads, *E*, *F*, *R* and *S*, it may be allowable to put them on the separate parts of the systems, provided they are equally distributed as represented. Motors should generally be supplied from the two outside wires (440 volts) as indicated at *N*, but if they are not large they may be connected to + and o conductors (220 volts) at *B* or *P*, and very small machines, such as fan motors, may be connected to adjacent wires (110 volts) at *E* or *R*. Arc lamps may be arranged as shown at *F* and *S*, or a suitable number may be put in series across the outside wires at *A* or *B*.

The Enclosed Arc Lamp.

BY L. B. MARKS.

(*Concluded from page 175.*)

The conservation of heat in the enclosed arc makes it possible to operate a carbon of given diameter at a relatively higher efficiency than in the open arc. Thus a carbon 11 millimetres in diameter operated in the enclosed arc lamp at a current of from 4 to 5 amperes, will give about the same efficiency relatively as a carbon 8 millimetres in diameter operated at the same current in an open lamp. This makes it possible to use a carbon of large diameter more efficiently in the enclosed lamp than in the open lamp. It is found, however, that with these small currents it is expedient for several reasons to use carbons appreciably larger in diameter than the size quoted above.

Firstly, with the larger carbons the radiation is more rapid and the temperature is decreased ; the efficiency, being a function of the temperature, is therefore also decreased.

Secondly, the amount cut off by the carbons themselves when the latter are large in diameter becomes considerable ; this applies especially to the rays cut off by the flattened tip of the negative carbon.

Thirdly, the coating of the internal surface of the enclosure cuts off light in proportion to the thickness of the deposit. It is well known that all carbons contain a small percentage of impurity, consisting chiefly of silica. When the carbons are consumed in the open arc, this silica passes off into the atmosphere. When the carbons are consumed in the enclosed arc, the impurity settles in the form of a thin coating on the internal surface of the enclosure. Although the amount of this deposit is very slight when the carbons are burned only for a short time, the amount of light cut off becomes appreciable when the coating thickens. It has been found in commercial operation in the United States, that after 100 hours' burning the decrease in the illuminating power of the lamp due to the formation of this coating is not noticeable by the consumer; after about 150 hours, however, the decrease in illumination becomes objectionable and it

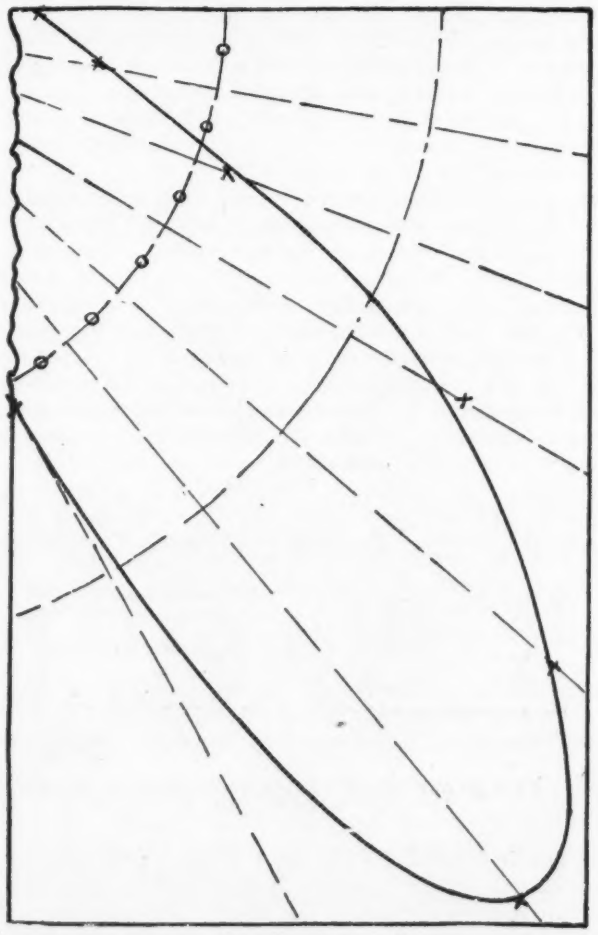


Fig. 9.—Candle-Power Curve of Open Arc.

is necessary to wipe out the enclosing bulb. Now with a pair of carbons 12.7 millimetres in diameter, the life as shown in the test which I have cited for you is about 200 hours. As a result of this long burning the light efficiency is cut down to an objectionable extent; hence in this case we are using a large carbon at the sacrifice of efficiency from all three standpoints mentioned above.

In the candle-power curves which I have given here for comparative purposes, the same difference in distribution of light will be noticed as in the case of the efficiency measurements. The mean hemispherical candle-power of the enclosed arc as determined from the curve is 431, the watts per candle being 1.17. The corresponding values for the open arc are 425 and 953. In the case of the enclosed arc the maximum candle-power as may be deduced from the curve is 595, while the corresponding candle-power of the open arc is 1080.

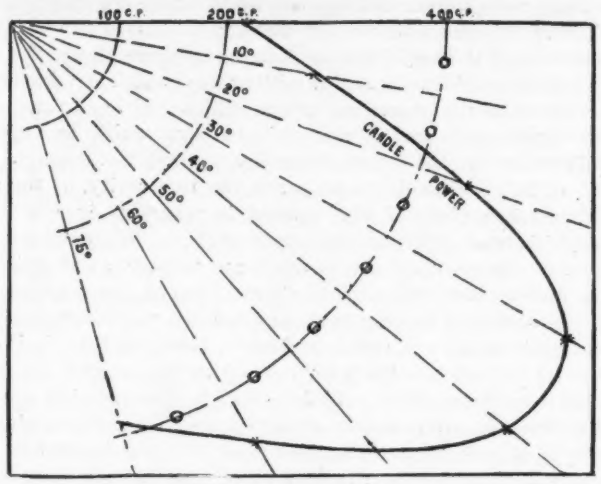


FIG. 10.—CANDLE-POWER CURVE OF ENCLOSED ARC.

The figures for the open arc are taken for a brand of carbon in extensive commercial use in the United States. In the candle-power curve for the open arc the readings begin at 200 instead of 0.

It will be noted that although the maximum candle-power of the open arc is almost twice that of the enclosed arc the mean hemispherical candle-power of the former is a trifle less than the latter; in general it will be found that because of the comparatively deep crater in the positive carbon of the open arc, the difference between the maximum candle-power and the mean candle-power is very great; in the enclosed arc, on the other hand, especially when the bulb is made of a slightly translucent glass, this difference is very slight.

A comparative test of candle-power of the open and enclosed arc lamps respectively was made here recently by one of the illuminating companies, and I submit the report of same to you. The candle-power measurements represent the relative illumination produced in actual practice. The open lamp was provided with the usual opal globe in common service here, and the enclosed lamp with an opalescent inner and a thin opal outer globe such as is used in the standard enclosed arcs. For the same wattage the excess of candle-power was slightly in favor of the enclosed arc lamp.

It is difficult, if not impossible, to obtain a true value of the effective illumination of an arc lamp, especially of the enclosed arc, in terms of candle-power. In interpreting the candle-power tests of arc lamps this fact must be taken into consideration. The quality of the light emitted by the enclosed arc differs from that of the open arc, and on this account comparative candle-power measurements must always be lacking, more or less, in truly representing the relative values of the lights. I have found in some cases that an enclosed arc, although producing actually less candle-power than an open arc, has given more *available* illumination, and on this account met the demands of the consumer better than did the open arc. The number of open-arc lamps which are daily being displaced by enclosed arcs in the City of New York alone is the best evidence in proof of the fact which I have cited.

TABLE VI.—CANDLE-POWER TEST "PIONEER" ENCLOSED ARC AND "WARD" 8 AMPERE OPEN ARC.

Mean watts arc, enclosed lamp	=	349
" " " open "	=	346
Excess of watts, enclosed arc	=	1 per cent.
" candle-power "	=	2¼ per cent.

Flush of Current. — The amount of current consumed at start by open lamps run two in series on incandescent circuits, is generally excessive compared with the normal current passed by the lamp. The amount of current consumed by such lamps just after the latter have fed often rises to a comparatively excessive point; this latter is true especially of lamps the mechanism of which has been clogged with dust or grit in the ordinary course of commercial usage. In the enclosed lamp which you have before you, on the other hand, the inrush of current, that is, the starting current, is practically as small as the normal current of the lamp; there is no excess of current after feeding, as in the other case.

TABLE VII.—FLUSH OF CURRENT IN OPEN ARC LAMP; RATED CURRENT — 10 AMPERES.

Time, Minutes.	Current, Amperes.
0.	25.
½.	20.5
2.	19.
2 5	16.3
3.	10.
3.25	21.
3.5	14.
4.	12.
4.5	12.
5.	11.
5 5	11.
6.	10.
6.5	10.
7.	12.
7.5	11.

Measurements made on an average pair of commercial open lamps are given below and will illustrate the above points. It will be noted from this table that the starting current of the lamps was 25 amperes; at the end of three minutes the current had fallen to 16 amperes, but then jumped up again to 21 ; the normal current was reached after 5½ minutes, the feed having taken place at seven minutes after start. Thus in this case the starting current was 150 per cent. and the current after feed 20 per cent. greater than normal. With many pairs of open lamps in commercial service the current after feed is often from 50 to 100 per cent. greater than normal. With the enclosed lamp the inrush of current does not exceed the average by more than 20 per cent. and the current after feed seldom rises over 10 per cent. more than normal.

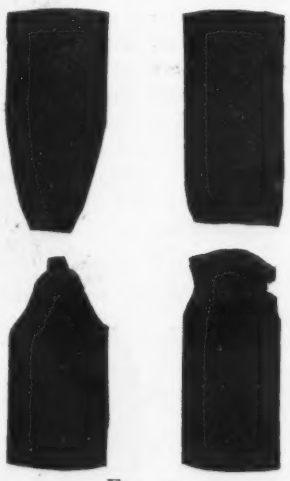


FIG. 11.
OPEN ARC, ENCLOSED ARC;
6 AMPERES; 45 VOLTS.

FIG. 12.
OPEN ARC; ENCLOSED ARC;
6 AMPERES; 85 VOLTS.

FIG. 13.
GRAPHITIC NIB ON SIDE OF CARBON NEGATIVE.

Formation of the Carbon Points and "Building" of the Negative; Observation of the Arc.—You are all familiar with the typical formation of the carbon points of an arc in open air. When the arc is enclosed in a small bulb, however, from which the air is excluded or to which it has very limited access, the carbon points take an entirely different form, even though the current and voltage of the arc be the same in both cases. Here are two pairs of carbon tips which have been operated under the same conditions except as

Fig. 14.—Metallic Negative with Graphite Carbon Nib.

to the enclosure. I have also presented photographs of these. The carbons were burned at six amperes in each case, the drop across the arc being maintained at 45 volts. You will note that when the carbons are burned in open air the negative is well pointed, while the positive tapers at the tip and has a well-formed crater. Contrasting this formation with that of the enclosed arc carbon points you will note that the positive in the latter case has a blunt and almost square tip and the negative instead of being pointed has a "mushroom" formation at its tip. The enclosed arc at the voltage cited was 1.7 millimetres long and the open arc almost 3.5 millimetres long between the tip of the negative and the centre of the crater in the positive.

When the voltage of the arc is increased, the carbon points assume a different shape. I give a photograph of carbons of the same quality and diameter as the last; these carbons were burned at the same currents, *viz.*: 6 amperes, but in each case the voltage was raised from 45 to 85. You will note that the formation of the carbon points in open air at 85 volts is entirely different than at the lower voltage; the positive carbon is eaten away for a greater part of its length and has no perceptible crater; the negative carbon instead of being pointed is rounded off at the tip. In this case the arc was about 15 millimetres long and "flamed" continuously. The formation of the points in the enclosed arc under the same conditions as to current and voltage is in striking contrast to that of the open arc. You will observe that the points are flattened and are indeed almost square; the positive and the negative tips respectively have almost the same shape: the arc in this case was nine millimetres long. The "mushroom" deposit or nib on the negative carbon which has been referred to several times, consists of graphitic carbon, which is deposited electrolytically on the lower carbon by the action of the arc. The deposit of this carbon is in no sense due to gravity, as the same formation takes place if the current is reversed, in which case the graphitic bead forms on the upper carbon. When carbons are operated in the enclosed arc at the same voltage as is ordinarily used in an open arc, this nib will always form on the negative, provided the access of oxygen to the enclosure is very limited. When the voltage is raised to a sufficient degree, however, this nib is eaten away or its formation entirely prevented; in the last case the carbon particles from the positive while in transit to the negative are combined with oxygen to form CO_2 and CO gases. The point at which the electrolytic deposit ceases to be fixed depends upon the current passing, the voltage of the arc, the amount of free oxygen present, and other conditions. The voltage of the arc in the high-potential low-current enclosed lamp is from 80 to 85, but even when this voltage is decreased to 70, as occurs sometimes on account of fluctuations on the circuit, the graphitic formation does not take place at small currents; when the voltage falls appreciably below this point the nib may make its appearance on the negative.

The attempt to utilize this principle to secure an indestructible negative has already been alluded to in the case of the metallic negative with the carbon nib, photograph of which is given herewith. In all cases where such negatives were used, it was of course necessary to separate at a low voltage in order to preserve the deposit intact. At this low voltage the arc is very short and frequently unsteady; moreover, the difficulty of adjusting lamps to meet the conditions required is very great. Aside from other disadvantages, there is always a deposit of uncombined carbon on the walls of the enclosure when a lamp is operated at low voltage in this manner. The "building" of the negative becomes quite marked in some cases where a more powerful current is passed. I have known an instance where the negative actually increased about two inches in length during a run of 11 hours, the mean current being 10½ amperes and the mean tension of the arc 50 volts.

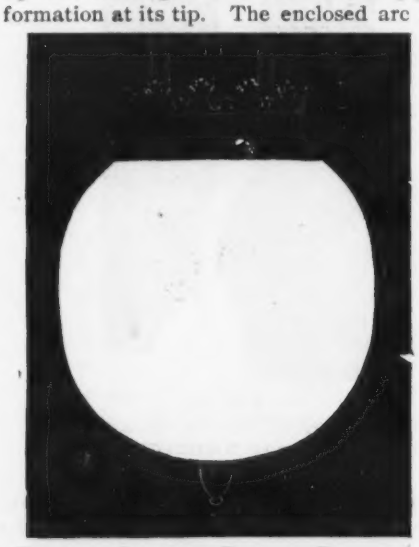


Fig. 15.—Showing Perfect Distribution of Light with Enclosed Arc Light

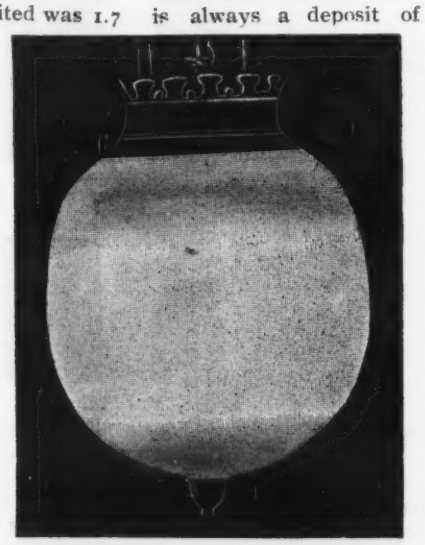


Fig. 16.—Showing Shadows on Globe of Open Arc Lamp.

Fig. 17.—Enclosed Arc Lamp for Outdoor Use.

Reference has already been made to the cutting off of light by the carbon points in the case of short arcs. When cored carbons are used as positives, which is generally the case in open arc lamps operated on incandescent circuits, the crater in the upper carbon assumes a distinctly concave formation ; the walls of the crater thus cut off a large percentage of light at and slightly below the horizontal, and the interposition of the negative carbon in such cases also decreases the angle subtending the zone of most powerful illumination. The shadows thus thrown by the upper and lower carbon points respectively, are distinctly discernible on the globe of the lamp. With the enclosed long-hour arc lamp, in which the carbons are separated from four to six times as much as in the case just alluded to, the concavity of the crater in the upper carbon is inappreciable, and the light is not intercepted by the side walls, nor cut off by the negative, as in the other case. I have taken photographs of two lamps, the latter being types of those which are in extensive commercial use in the United States, the one an open lamp showing shadows on the globe, the other the enclosed lamp with shadowless globe. The open arc lamp referred to was of the common 10-ampere type, operating at from 40 to 43 volts at the arc, with cored upper carbon 12.7 millimetres in diameter, and solid lower carbon 11.11 millimetres in diameter. The enclosed arc lamp was of the five-ampere type, operated at from 80 to 85 volts at the arc; solid upper and lower carbons, 11.11 millimetres in diameter, were used. You will note from the photographs that in the open arc the shadows on the globe are very marked, while the enclosed arc globe is shadowless.

In the case of the open arc, especially where cored carbons are used, the crater tends to centre itself in the positive carbon. With the enclosed arc, however, the crater tends to wander ; instead of issuing from a pointed negative tip located directly below the centre of the positive, as is the case with the open arc, the arc stream of the enclosed arc issues from consecutive points along a flat surface, the crater in the positive always tending to be almost directly above the point from which the arc issues. The area of the crater increases with the current strength ; hence the greater the current density, the less marked are the migrations of the arc. When carbons not larger in diameter than about 11 millimetres are used in the high potential enclosed arc lamp, the wandering of the arc is not objectionable, especially when the diffusion obtained by the use of the inner bulb is marked. The lamp which I have burning here you will note is very steady ; the diffusion of light is so perfect that the eye does not detect any motion of the arc.

Conclusion.—It will be noted that in considering the commercial application of the enclosed arc light attention has been concentrated on the adaptability of the lamp to direct current constant potential circuits. The introduction of enclosed arcs on circuits of this class has been phenomenally great in the United States during the past year, the open constant potential lamp being gradually relegated to the past. The field for the enclosed arc light, it is believed, will rapidly widen, the application to alternating current circuits being already an accomplished fact, while the adaptation to constant current high-tension circuits will be simply a question of time. Summarizing, we may set forth the advantages of the commercial enclosed arc over the open arc as follows :

1. Cost of carbons about one twentieth of that of the open lamp.
2. Cost of attendance about one tenth of that of the open lamp.
3. The annoyance of daily trimming no longer an objection to the arc lamp.
4. Absence of shadows of the carbon points ; uniform distribution of light.
5. One or more lamps on small amperage, operated independently.
6. Cleanly; carbon dust entirely consumed.
7. Formation and escape of sparks prevented.
8. No flush of current at start or feed.
9. Simple lamp mechanism.

In conclusion, I desire most kindly to acknowledge the courtesy of those who have assisted me in the presentation of the subject this evening. I trust this society will also accept my sincere thanks for the honor conferred on me by the invitation to address you on the subject of "The Enclosed Arc Light." Naturally it has been difficult for me to condense the experience and researches of years into a short address, but I trust I have thrown at least some light on the subject and opened up the way to further research and development.

Gaseous Fuel as a Means of Cheapening Electricity. *

BY NELSON W. PERRY.

In these days of extending areas to be reached by electric light and power companies the management is constantly being put into a quandary as to how they are to be reached. In electric lighting enterprises employing the direct current the areas that can economically be reached are already pretty well covered and these are the best paying areas. Just beyond there is new business to be had if it only could be supplied, but to supply it would involve additional outlays far out of proportion to the reasonable expectation of immediate returns. The management therefore feel that they must for the present at least forego the immediate increase from these outlying districts and must depend for new business upon the natural or stimulated growth of custom within the districts already partly supplied.

Where the alternating current is employed very largely increased areas are so easily made tributary to the central station that the temptation to supply scattered customers has been in most cases too strong to be resisted, and I believe if reliable statistics could be compiled they would show that alternating-current lighting stations have proved far less profitable as a class than have those using the direct current. The very limitations which have prevented the direct current entering the field to which the alternating current is best adapted, having proved its greatest safeguard.

A comparative study of a very large number of load-lines of direct and alternating-current lighting stations discloses a peculiar state of affairs, *viz.*, that as a rule the alternating-current load-lines have almost uniformly a squarer and broader topped peak than have the direct-current stations. This is largely due in some cases to the fact that in the scattered service of the alternating current a very much larger proportion of the total output is employed for street lighting, but it is also partly due to the undoubted fact of the larger proportionate losses at light loads due to transformers and other losses peculiar to the alternating current, which makes the mean load higher than it should be. This feature is particularly observable in the curves of an alternating-current station, of which I have diagrams for nearly every day in the year, which supplies such a small proportion of its total output to street lights as to render the effect of these practically negligible.

With the direct-current system, the introduction of high-voltage lamps which have already demonstrated their feasibility abroad and to a less extent in this country will be a partial solution of the question of supplying greater areas if it does not lead to the same temptation which has beguiled the alternating-current manufacturers, for of this there is constant danger.

In electric railways, in which distance rather than areas are involved, the question is far more serious, for in this latter case the cost of distribution increases almost strictly as the square of the distance, whereas in electric lighting the cost approaches more closely to a direct proportion to the distance.

This comparison becomes more strictly true when we consider the suburban extensions of our electric roads, which in fact now are becoming about the only extensions open to our street railway managements, and the unfavorable character of the comparison puts the street railway problem in a still more unfavorable light when we consider that in the outlying districts the immediate traffic to be gained by the largely increased outlay is disproportionately small to that outlay and of a far more irregular character.

In order to make such new lines profitable at all it has become quite popular to stimulate traffic by inaugurating pleasure resorts and providing amusements at the further end of the line. The wisdom of this is questionable, for to provide for this induced traffic, provision must be made both in the way of increased plant and additional copper largely in excess of the natural demand. This increased provision is at best utilized but a small portion of the time and the earning capacity of the investment as a whole is greatly decreased.

Returning to the electric lighting industry, it is at best on an unsatisfactory basis and something must be done to better it. In the most desirable locations, which are in our largest trade centres, such as Chicago, New York and Boston, where probably of all places in the world the electric lights are most dense, and therefore where they can be supplied at least cost for distribution, what do we find? We find these companies whose stocks are selling above par and

* Abstract of a paper read before the Northwestern Electrical Association.

which are paying dividends regularly, making new issues of stocks and bonds or applying for permission to do so, in order "to raise funds for extensions."

Take the New York Edison Illuminating Company as an example, whose stations are perhaps as favorably located as any to be found, and whose stock is selling above par. It has a capital stock of $10,000,000 of which $7,938,000 have been issued, and of bonds $7,118,000 of which $6,430,000 have been issued, making a total authorized capital liability of $17,118,000 of which $14,368,000 has been issued.

According to its report for 1895 its total maximum capacity was 75,000 amperes or the equivalent of 150,000 sixteen-cp lamps. According to Mr. John W. Lieb (Transactions Am. Inst. Electrical Engineers, 1895 p. 56) the load factor of the combined Edison stations on the greatest output in 1894 (Dec. 10) was 34.5 per cent.

To compare the capital outlay for electrical service with that required for equivalent gas service is exceedingly difficult; first, on account of the paucity and unreliability of gas statistics, and second because of the well-known enormous over-capitalization of gas enterprises in New York, partly due to the watering of stocks and partly to the duplication of plants that would have been totally unnecessary had the gas industry grown legitimately under a single head instead of being the outgrowth of repeated consolidations of competitors in the same territory. But taking these statistics as we find them, the total authorized capital of the various gas companies, including stock and bonds, is given as $58,109,000 and their united annual output, as near as I can get it (average of two estimates by different gas authorities) 14,000,000,000 cubic feet. This gives a mean output per hour of 1,600,000 cubic feet. Counting 5 cubic feet per hour as the equivalent of a 16-cp incandescent lamp this means an average supply of 320,000 lamps, and if the load factor be assumed the same as given for the Edison stations it means a maximum supply for something more than 927,000 burners. This is in round numbers 6.2 times as many lights as the Edison Company on a total authorized capitalization of $17,118,000 is able to supply. On this basis the capitalization necessary to supply the same number of lights as the gas companies can now furnish, would be $106,000,000 as against $58,000,000 for the gas companies. For many reasons, some of which have been specified, the comparison is manifestly unfair to gas, and it seems not at all improbable that gas service can be supplied on a capitalization of not to exceed one fourth (instead of one half, as shown above) that required for equivalent electric service.

There is certainly something wrong in this state of affairs which the electrical engineer must correct. The most significant feature of the situation is that notwithstanding the fact that gas is distributed over very much greater distances than low-tension currents are, the consumer can buy it so cheaply that he can produce electric light more cheaply by burning it in a gas engine, even after incurring the losses in conversion in the engine and dynamo, than he can buy it from the electric company. If this be true in large cities like Chicago, New York, Philadelphia, Brooklyn and Boston, and it cannot be gainsaid, what must be the condition of light and power plants in smaller and less favorably situated cities?

Some, by rigid economy and the best of management, are making a little money; more are running on a very close margin, and still more are undoubtedly ekeing out a precarious existence while their machinery is wearing out and making no provision for its replacement when it requires renewal, and all are charging more for their light than gas can be and is furnished for, where gas is furnished at all. It is very clear if the electric light could be furnished at a small profit at the same price as gas, it would furnish an enormous increment to the electric light manufacturers' income. The advantages of electricity as a useful agent in the household over gas are so apparent that there could no longer be any competition between the two. It would result in larger profits for those companies now making money, and place most of those now operating at a loss upon a dividend-paying basis.

Our electric railways, except in exceptionally favored situations as in our larger cities, are in no better condition than the lighting companies, if in fact they are in as good condition.

Our electrical engineers have bent every effort to ameliorate matters, and the best of our electrical stations are now models of mechanical and electrical engineering skill. Boilers of the highest efficiency, engines of the greatest economy and all the accessories, have been brought to a state of perfection which leaves little expectation for improvement in those directions. Greater distances have been brought under the service of existing stations by means of the booster and of subsidiary outlying storage battery centres of supply, and the load line has been leveled off by the storage battery plants at the station itself, and yet the most optimistic will not maintain that finality has been reached, or that the desired end has as yet been accomplished. Electricity can be produced at the station by large compound condensing engines more cheaply than can gaslight at the gas works.

If we assume that illuminating gas costs but 20 cents per 1000 cubic feet to manufacture and that 5 cubic feet per hour are consumed to produce 16 candle-power, the cost per light per hour at the gas works would be 1/10 of a cent. If, on the other hand, we assume that an electrical horse-power-hour can be produced at the central station for 1 cent and that 13 fifty-five-watt lamps can be supplied thereby, they would cost 1/13 of a cent per hour.

When we still further consider that recent tests in England have shown that a brake horse-power can be produced under test conditions in a gas engine on 14 cubic feet of ordinary town gas (16 candle-power) and that such gas costs delivered, in our large cities, only about $1.50 per 1000 cubic feet, it becomes evident that we can pay the gas company its profit on manufacture, distribution and collecting and still produce electric light in our central station at a less cost than gas light; and yet when we have distributed our energy to our customers we must charge them more than the gas company does, light for light, and then be satisfied with far less profit on an increased investment than the gas company gets on its lesser investment. It seems to me that this indicates something radically wrong and in a direction to which our engineers have given little attention, *viz.*, in our methods of distribution.

We have constantly striven to increase our radii of distribution, and have done this until we could go no further and give satisfactory service. We have then built additional stations, and many managers now find themselves again confronted with the same question: Is it possible for me to increase my radius, or must I decide between foregoing the increased business just beyond my reach or, taking the bulls by the horns, build another station?

Unquestionably the gas engineer has the advantage of the electrical engineer in his method of distribution, but he has this advantage solely through the apathy of the electrical engineer and not through any inherent right. The facts are indeed the other way, for the pressure at which the gas engineer may distribute his gas is limited to that at which gas can be burned at its most efficient rate. No such limitation is placed upon the engineer who distributes gas for fuel purposes. Compressed air is being daily delivered through 20 miles of pipes with a pressure at the point of delivery of approximately 100 pounds to the square inch, and a leakage loss not to exceed 10 per cent., and gas for fuel purposes can be delivered through the same pipes at the same pressure and leakage, whereas for illuminating purposes the final pressure is limited to a fraction of a pound in pressure to the square inch, but even under these conditions the Consolidated Gas Light Company of New York is distributing gas from the Harlem River clear down to the Battery, a distance of 13 miles, and the Gas Light & Coke Company, of London, is delivering gas over 70 miles of territory through 2000 miles of mains, to a distance of 17 miles from its stations. On the same investment in pipes therefore a far greater gas delivery can be made for power purposes than can be made for lighting purposes and the electrical engineer who will deliver his energies to his centres of distribution in the gaseous form will have an enormous advantage over the gas company by reason of his ability to distribute his gas at greater pressure.

But he must be careful not to throw away the advantage thus gained by distributing his electrical energy over too extended areas. It is my conviction that the tendency to increase the radius of distribution is in the wrong direction and that our solution is in the contrary direction, *viz.*, in increasing the number of our centres and decreasing the radii.

The first step would be to move our generating plants from the expensive sites now occupied and place them on the cheaper land where fuel and water may be had most cheaply. If by this move we can save in our coal bill 54 cents on every ton of coal costing say $2.50, we have at once made a material gain in operating expenses as well. If by adopting gaseous transmission we can cover a vastly increased area at the same cost, we have made another gain, and if by converting our coal into gas we are enabled to utilize coal that costs $1.00 or $1.50 per ton whereas before we were paying $2.50, another material gain has been accomplished.

If, by the reason of the exceedingly cheap method of gas storage, which, when employed on a large scale, can be provided on an investment of but $1.50 per hp-hour capacity, we can employ the real

estate occupied, the buildings, apparatus, labor and administrative force to their fullest capacity, we have again reduced very materially both our fixed charges and our operating expenses.[1]

We have seen that one gas company in London is supplying 70 square miles of territory through 2000 miles of pipes with a leakage loss of but a fraction over 5 per cent., and that it has a straight-away transmission of 17 miles. The economical distribution of gas over areas much larger, and to distances much greater than have ever been attempted electrically is therefore no longer an experiment, but an accomplished fact, and this fact becomes still more impressive when we realize that after paying all the expenses of such transmission and the gas company's profit, we can buy that gas and produce more light from it through the intermediary of the gas engine and dynamo, at less expense than we can buy electric light, or than we could get from the same amount of gas burned in the ordinary way.

If these be facts they are very impressive. and should stimulate us to see how far we as purveyors of electric power and light can avail ourselves of them.

Relation Between the Speed and Efficiency of a Dynamo.*

BY ARNOLD G. HANSARD.

A problem in dynamo design, which is of some practical importance is to find the speed which gives the highest efficiency.

The following is a graphic solution of this problem, and gives the rather unexpected result that the speed which gives the highest efficiency is that which makes the eddy-current losses equal to the I^2R losses. Certain assumptions, to be discussed further on, are made; these are (1), that the output varies as the speed; (2), the I^2R loss at full load is the same for all speeds; (3), the hysteresis and friction losses are proportional to the speed; and (4), the eddy-current losses are proportional to the square of the speed.

Along OA and OB, drawn at right angles to each other, take abscissæ and ordinates proportional to the speed and losses respectively; take OC = the I^2R losses, and draw CD parallel to OA; draw CE so that the ordinates from it to CD (as $e'd'$) are proportional to the hysteresis + the friction losses; by assumption (8) CE will be a straight line; draw CF so that the ordinates from it to CE (as $P'e'$) represent the eddy-current losses; since by assumption (4), P' being any point on CF, $P'e'$ is proportional to $(ON')^2$, and is ∴ also proportional to $(Ce')^2$, it can easily be shown that CF is a parabola touching CE at C and having its axis parallel to OB.

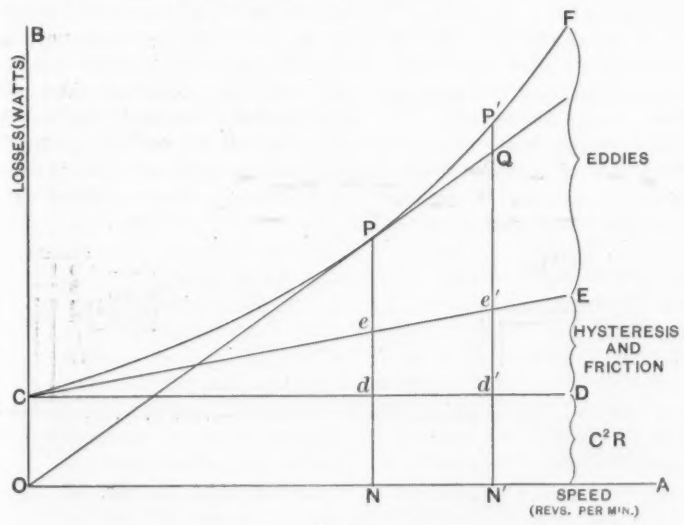


FIG. 1.

Draw OP to touch this parabola CPF at P; then $PedN$ being the ordinate drawn from P, N will give the required speed of highest efficiency.

For if P' be any other point on the curve CF, and $P'e'd'N'$ its ordinate, cutting OP in Q; by assumption (1) the outputs at the two speeds corresponding to N and N' are proportional to PN and QN', since $QN' : PN$ as $ON' : ON$; but since the total losses are represented by PN and $P'N'$ respectively, and $P'N'$ is $> QN'$, the ratio $\frac{\text{losses}}{\text{output}}$ is smaller for the point P than for P'; *i. e.*, the point P determines the speed of highest efficiency. Now it can easily be shown by the geometry of the parabola that $Pe = CO = dN$, *i. e., the speed of best efficiency is that which makes the eddy losses equal to the I^2R losses.*

The five conditions assumed above are strictly true for any given dynamo, *e. g.*, if we take a dynamo wound for say 100 volts at a certain speed, and double the speed, keeping the same magnetic densities, we shall be able to take from it double the output, *viz.*, the same current at 200 volts. The shunt field will, it is true, require a resistance to be placed in its circuit; but if we rewind it with a suitable wire the losses in it will be the same as before using the same weight of copper; the armature I^2R will of course be the same, and while the hysteresis and friction will be doubled, the eddies will be quadrupled. Speaking generally, if we take a dynamo carcase of given dimensions and wind it for any speed and voltage, (1) the ratio $\frac{\text{maximum output}}{\text{speed}}$ is constant for a considerable range, and would be strictly true if the magnetic densities and also the armature ampere-turns were kept constant. In practice, if the voltage is not decreased with the speed, the exigencies of space may compel us to reduce the output below this proportion to prevent the current density becoming excessive. (2) The I^2R loss in the field windings will be constant for the same weight of copper, and, except in extreme cases, when the space taken up by the insulation becomes excessive, it will be possible to get this on to the field-magnets, and the same remarks apply to the armature winding. (3) The magnetic density being kept the same the hysteresis will vary simply as the speed. (4) In the case of smooth-cored dynamos, the eddy loss will vary simply as (speed)^2 provided the degree of lamination of the conductors and the distribution of the field is kept the same; conditions not far from the truth in the case of large and moderate-sized drum armatures. In the case of slotted armatures, since the copper is practically free from eddies, those in the iron of the armature and in the pole-faces alone remain; the latter should in any case be negligible, if the teeth and slots are properly proportioned to the air-gap; and the eddy loss will not depart much from the assumed proportion unless the number and dimensions of the teeth have to be very considerably altered to suit the different speeds.

The above result can easily be got at by differentiating. Thus, if n = speed,

Wn = output, proportional to speed,
an^2 = eddies, proportional to (speed)^2,
bn = hysteresis + friction, proportional to speed,
$c = I^2R$ loss, constant,

$$\text{Efficiency} = \frac{Wn}{Wn + an^2 + bn + c}$$

Then the condition for a maximum is $\frac{d}{dn}\left(\frac{Wn}{Wn + n^2 + bn + c}\right) = 0$ which gives, on differentiation, $an^2 = c$, or eddies $= I^2R$.

Telephones in Germany.

According to London *Engineering* the telephone system in Germany has, during the last few years, been extended in all directions, both between the different points of Germany, within the various towns, and with other countries, so that the aggregate mileage of the lines, and the number of telephone conversations, are now four times larger than was the case five years ago.

A number of still longer and more important lines are being constructed or contemplated, comprising a line from Bremen to Amsterdam, a new line Berlin—Vienna, with stations in Dresden and Prague; Berlin—Brussels, Berlin—Budapest, and Berlin—St. Petersburg. It goes without saying that this almost universal telephone system is of immense value to the commerce and industry of the German capital, the more so as the charges are moderate, the longest distance charge generally being 75 cents for a three minutes' conversation. The long-distance lines are all double, the wire varying between two, three, four and five millimetres, according to the distance. Nearly all the drawbacks from the practical value of long-distance telephones, such as induction, etc., have been successfully overcome during the last year or two.

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[1] A 500-foot holder would cost, erected in New York, about $700; a 1000-foot holder, $900 to $1000; a 150,000-foot holder, $15,000, and a 3,000,000-foot holder $180,000. Assuming that a gas engine requires 25 cubic feet per horse-power hour, which is exceedingly liberal for the best types of modern gas engines, using gas of the average quality of our ordinary illuminating gas, the investment per horse-power hour capacity for the largest sized tank would be as given.

* From advance proof sheets of the London *Electrician*.

The Application of the Storage Battery to Electric Traction.

In a paper read before the Franklin Institute, on Dec. 5, 1896, Mr. Charles Hewitt gave the results of some valuable experiments on the use of storage batteries for traction purposes. The several methods considered were: First, the application of the battery on the car locomotive; second, the application of the battery to long lines; third, the application of the battery in the power house itself.

Mr. Hewitt first stated that the history of the storage battery on the car itself was a chapter of most remarkable failures It is a strange fact that in spite of the continued and unbroken series of failures, involving the loss of many thousands of dollars, that even at this day capital is quite readily obtained for continuing the experimenting in this line, but these experiments, although very costly, have had the effect of materially assisting in the rapid development of the battery, for there is scarcely any application of the storage battery which is so severe as its application to the car locomotive. He then referred to the unsuccessful attempts which have been made in New York, Washington, and Dubuque, Ia., and gave his own experiences in a test made on the Ninth Avenue line, New York, running from Fifty-fourth Street and Ninth Avenue to 125th Street, a distance of nearly four miles. The road has numerous grades of from 2 to 6 per cent., and in these trials the regulation was maintained by commutating the battery. It was found in these experiments that the fall of E. M. F. on heavy discharge was considerable, and this is always the case when the volume of current flow exceeds a certain amount per unit area of plate. This amount varies somewhat in different forms of cells, and the important point which he brought out was that it seems impossible from the nature of the conditions existing on the car to make a cell with a sufficiently large area of plate to withstand the heavy discharges without loss of E. M. F. and at the same time be sufficiently light to be carried on the car. In these experiments the maximum speed attained was 12 miles an hour, a very slow speed compared with trolley cars. The E. H. P. per hour mile was found to average 1.07 for the trips, including the 6 per cent. grade and 0.8 for the trip, not including the 6 per cent. grade. The batteries were always charged immediately after the run and after standing over night they were found to have lost so much as to make an extra charge necessary. This loss has been previously noted by writers on storage batteries and is probably due to local action of the battery itself and partly to surface leakage. The loss is indicated by the loss of E. M. F. on open circuit. The average E. M. F. per cell at the end of the main charge was 2.35 volts, and after standing over night this had fallen off to 2.09 volts per cell. This is a well-known trait of all lead batteries and it affects the efficiency of the cell considerably.

The total watt-hours consumed in charging and the time were carefully noted, as well as the watt-hours in the output; from this the following important results are derived: Total watt-hours output divided by the watt-hours charge shows an average useful efficiency of only 44 per cent., for the trips including the 6 per cent. grade and 45 per cent. for the trip not including the 6 per cent. grade. The ampere-hours efficiency, generally referred to by storage battery manufacturers, Mr. Hewitt stated, was calculated to be approximately 64.7 per cent. for the trips including the 6 per cent. grade, and 64 per cent. not including the 6 per cent. grade.

The figures also show that even on a comparatively level road it is not to be expected that a much better useful efficiency could be obtained, but a car would make a greater number of car miles on one charge. The low efficiency is undoubtedly due to the extra charge and the overcharging, but if cars were run in actual service either of the batteries would have to be kept under a continuous charge when not on the car, in order to prevent loss by local action, or else they would have to receive an extra charge before being put into service. In a regularly equipped road, Mr. Hewitt stated that the following losses in efficiency might be looked for: The loss in engines and dynamos is 15 per cent. and this can only be obtained with direct-connected units. The loss in batteries is 50 per cent. this is 6 per cent. better than that shown in the above record; loss in motor and gearing 25 per cent. of the power delivered to the motor. The total efficiency therefore from the indicated power in the engine to the power delivered to the car axles is 32 per cent. From these results Mr. Hewitt calculates that for each hour of run, including the 6 per cent. grade, 2⅓ hours charging are necessary, and not including the 6 per cent. grade, 1.43 hours are necessary. This has a very practical bearing, as it means that in the first case at least an average of 33⅓, and in the latter, 2.43 complete sets of batteries must be maintained for each car. Undoubtedly on a regularly equipped road this could be improved, but granting an improvement of 15 per cent., it would require two hours charging for each hour of run in the first case, and about 1¼ hours in the second case, so that at the very best three sets of batteries would have to be maintained in either case. He finds that the average power required in charging to be a little over eight E. H. P. Taking an average of eight E. H. P. required at the battery, and two batteries per car undergoing charge, and allowing 15 per cent. loss in engine and generator leads, he finds that an average engine output of 1.88 horse-power per car will be required. For ordinary trolley roads from 10 to 12 horse-power is the rule. For the battery referred to in this case the output of the station per car mile will vary from 1¾ E. H. P. hours to 2½ E. H. P. hours; whereas, for trolley cars the output seldom averages over one E. H. P. hour per car mile. Mr. Dawson has stated that the power per car mile required at the power-house in Paris, with lead batteries, was 1.5 E. H. P. hours; in Berlin, with lead batteries, 1.44 E. H. P. hours; in Vienna, with copper-zinc batteries 1.71 E. H. P. hours. Thus it will be seen that the battery car even on a regularly equipped road will require at least 50 per cent. to 75 per cent. more E. H. P. hours than are required by a trolley car. Mr. Hewitt called special attention to the difference between the working E. M. F. and the E. M. F. on open circuit; this represents a direct loss.

Mr. Hewitt then referred to the disintegration of the lead grid that holds the active material. In the ordinary well known forms of batteries it seems to be a well-established fact that if the current density in a cell is kept within certain limits, the lead grids are but slightly attacked or disintegrated, but when cells are subjected to frequent current density much beyond their normal current density the lead grids themselves are attacked and disintegrated. As the weight of the traction battery must be kept to the minimum limit the grids are necessarily as light as possible, and in consequence, comparatively little disintegration will so affect the mechanical strength of the grid that it soon goes to pieces. Mr. Hewitt states that six months seems to have been a good life for a positive plate, whereas the average life has been nearer to three or four months.

Mr. Hewitt then referred to some 15 roads which are being operated in Europe on the so-called mixed system of using a storage battery in conjunction with an overhead trolley. He stated that from what he could learn the ordinary arrangement was to install 200 cells on each car. These cells are capable of running the car only five or six miles, and are used for propelling it after it leaves the trolley line. While on the trolley portion of the road the cells are being charged at their average pressure of 2.46 volts per cell. This has the effect of loading the feeder wires by just the amount additional that the battery will take which will decrease their efficiency also. From the latest reports obtainable he concludes that the whole arrangement appears to be a makeshift due to the local conditions, but the companies operating these batteries are in hopes that in the near future the city authorities will allow the overhead wires over the entire road, thus doing away with the batteries.

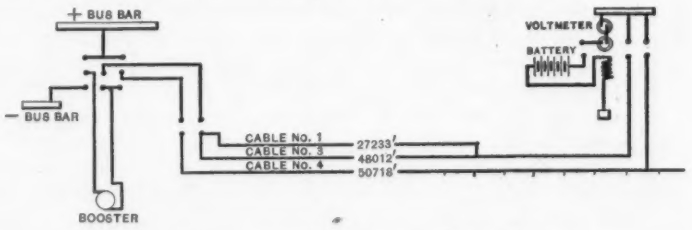


Fig. 1.—Diagram of Chestnut Hill Cables.

Mr. Hewitt stated that the short life of the positive plates has been the great drawback to all forms of traction batteries. He stated that there was no doubt in his mind that improvements in the recent batteries have greatly lengthened their life, but there is no evidence obtainable to show that the efficiency is any greater than 1.1 to 1.2 kw-hours per car-mile on a fairly level track.

The application of storage batteries on the ends of long lines was then considered.

In such applications the conditions are entirely different. The battery in this case acts essentially as a pressure regulator. The conditions do not restrict the size of the plates, so that the plates can admit of such a size that the current density on discharge per unit

area of plate can be kept well within the limits of normal discharge; and in consequence of this, the battery is not subject to the great loss of efficiency, due to the fall of E. M. F. on discharge.

Only a few such installations have been made, two of which are on the Isle of Man; one has been installed by the Anaconda Mining Company at Butte, Mont.; there is also a small plant at Merrill, Wis. The first installation, however, that has been made for any large city road for its suburban service, he finds, is the one installed by the Union Traction Company of this city at Chestnut Hill.

The road was originally a horse car line which ran as far as the depot at Pelham. Conduits and cables were installed for operating a number of cars which were supposed to be amply sufficient. The phenomenal increase in travel, however, necessitated a large increase in the car service. In addition the success of the line warranted its extension to Chestnut Hill and the service was extended as far as Chestnut Hill Avenue, which is at the top of the long grade descending into the Wissahickon Valley. More recently the line has been extended down this grade to Hillcrest Avenue and from Hillcrest Avenue to the Wheel Pump on the Bethlehem Pike. With the first extension of the line to Chestnut Hill the underground cable was also extended, but the drop in pressure over this long line made it impossible to run the requisite number of cars, as the speed of a trolley car is approximately in the direct ratio to the applied E. M. F. The cables for feeding this section consisted of one cable extending to Chestnut Hill, one to Chelten Avenue and one to Wayne Junction, about five miles from the station; all these cables were 1,000,000 circular mils copper, rubber-covered and leaded, laid in terra cotta ducts. The investment for feeders in this line had already reached a point considerably over $100,000, not including the tracks. To have increased the cable so as to supply this section properly would have required about seven cables of 1,000,000 circular mils and of 48,000 feet each at $1.05 per foot laid, which would amount to $352,800. Deducting the value of cables 3 and 7, which were already laid and which are estimated at $79,000, it was found that the extra cost for cables without conduits would have been $273,800; the question then resolved itself into the necessity of building a station or providing some other means of keeping up the pressure. If a station had been built at Chestnut Hill it would, of necessity, have been small and inefficient. From records taken of the main power-house it was found that it would be necessary to provide a station of about 750-kw capacity; such a station would have cost about $85 per horse-power or a total of $85,000. A battery station, on the other hand, required but little real estate, and would be inexpensive to operate; its cost would be considerably less than a power station. In the Chestnut Hill plant the entire cost of real estate, battery and building, was approximately $25,000; to this must be added the cost of a booster in the main power-house. It was found that this required a 200-kw generator, which with its engine would cost about $8000. The total cost of battery and booster would therefore have been $33,000. In this installation, however, a 500-kw generator at the Beach Street power-house was adapted to this service, so that although its service was lost for 500-volt work, it cost but little extra expense in the power-house for adapting it to booster purposes. It was found therefore that, deducting $33,000, the cost of the battery and booster, from $85,000, the cost of a station, that the difference in first cost is $52,000 in favor of the battery. In addition to this they were put to an expeuse of a little over $13,000 for changes in the cable. In the estimates that follow Mr. Hewitt did not include any cost or interest on the cable, as the investment would have been about the same whether they had built a station or installed a battery. It is very apparent therefore from the facts given that on the score of first cost the battery was by far the cheapest installment which they could be made. In order to better understand the results which Mr. Hewitt proposes to give in reference to the operation of this battery, he describes the plant somewhat more in detail.

There are three cables concerned in this work, which were numbered No. 3, No. 4 and No. 7, all of 1,000,000 circular mils capacity; the lengths of these cables are shown in the diagram. Cable No. 4 is the only one which supplies the trolley wire direct; or, in other words, all the taps from the underground cable to the trolley wire are tapped on cable No. 4; this cable runs all the way from the bus-bar at the Beach and Green Street power-house to the end of the line on the Reading Pike at Chestnut Hill. It feeds all of Germantown Avenue from Wayne Junction, and also the line on Chelten Avenue, making in all about 12 miles of trolley wire. Cable No. 3 runs direct from the Beach and Green Street power-house to the bus bar at the battery house, as shown in the diagram. Cable No. 7 simply augments the capacity of cable No. 3.

In ordinary operation the current on cable No. 3 passes through the booster at the Beach and Green Street power-house, by which the initial pressure is raised 150 volts more or less above the ordinary bus-bar pressure of 530 volts. By this means the drop in the cable is overcome, so that they are able to adjust the pressure at the battery house to a point where the battery varies but little to each side of the zero point, or, in other words, it charges and discharges continually, maintaining the load on cable No. 3 nearly constant, and consequently maintaining a constant E. M. F., where the current passes out from the battery house through cable No. 4, as shown in Fig. 1. This cable (No. 4) is therefore fed from two points, namely, from the Beach Street end at 530 volts, and from the Chestnut Hill end at a little above 500 volts. As a consequence, the distribution along the line from Wayne Junction to the end at Chestnut Hill is comparatively uniform, and is now very satistactory. When the load on the line is low, the current going over the cable No. 3 to the battery house divides at the bus bar, one part supplying the necessities of the line, the other part charging the battery. When the demand on the line is heavy the pressure drops a little at the battery house; all the current going over cable No. 3 will pass out over cable No. 4, and in addition the battery will discharge sufficiently to make up for the extra demand for current. This has the effect of keeping an almost constant load on cable No. 3.

After several months' experience with this equipment it has been found that at times the load on cable No. 3 becomes so heavy as to reach the maximum pressure which the booster will generate. With the speed at which the booster is now operating, this maximum is about 250 volts; at such times by an arrangement of switches at the Beach street power-house, shown in Fig. 1, cable No. 4 is thrown on the booster as well of No. 3. In doing this the current through the booster is largely increased, but the pressure is reduced to about 125 or 130 volts, and in addition a battery pressure at the Wayne Junction end of the section is effected.

This method of power distribution cannot be considered economical *per se*, but where the conditions are such as we have described, and the question is simply whether a power-house shall be constructed or a battery installed, I think there is no question as to the economy in favor of the battery.

There are many such lines in the country as the Chestnut Hill Branch in this city, and it is interesting to note that railway engineers throughout the country are giving this matter much more serious consideration now than in the past.

In the application of the battery in the power-house the battery becomes a load regulator rather than a potential regulator, as in the previous case. The object of a battery is to even up the load on the generators, so that the engines may run at the point of maximum economy.

There is an absolute lack of data on this method of applying the battery, as very few stations have so far been equipped. There are a number of these stations in Europe, and such reports as we have received show very satisfactory results. In this country such a battery is now being installed at Easton, Pa.

In the discussion which followed the reading of the paper, Mr. Hewitt stated that theoretically it would pay to put in a generating station, when the extra cost per unit, due to the booster, would equal the difference in cost per unit between the cost per unit at the larger station and the cost per unit at the smaller station. In the particular case under discussion it would probably pay to put in a generating station at Chestnut Hill when the load on that section reaches the capacity of the present cables. The less work the battery does the higher will be the efficiency. In other words, the battery should be used simply as a potential regulator. The maximum permissible output, in the case under discussion, is 500 amperes, but the maximum economical output is zero output.

A Criticism.

To the Editor of The Electrical World:

SIR:—I think my name has been on your subscription list continuously since THE ELECTRICAL WORLD bore its present name, and as I have never before troubled you with a complaint, may I venture to take exception to some of the remarks accompanying the excellent portrait of Mr. Sprague in your issue of Jan. 16?

It is there unequivocally stated not only that Mr. Sprague "first utilized electricity as motive power for surface roads," but that he "built the first electric railway and demonstrated the success and feasibility of his invention in Richmond, Va."

With the latter part of the last quoted sentence, no one familiar with the facts will cavil, but on behalf of our mutual friend, the late Mr. Van Depoele, if for no other, I protest against THE ELECTRICAL

World lending the weight of its great authority to a statement utterly at variance with fact on a subject of such importance. When the daily newspapers make such sweeping assertions, no one cares to correct them, for obvious reasons, but when technical journals of high standing indulge in these flights of fancy, surely it is time to record a mild remonstance, especially in view of the fact that Mr. Sprague, whom we all delight to honor, has no need of aught save the unvarnished truth to easlly hold his place in the front rank of the brilliant engineers who met to celebrate the bringing of Niagara power to Buffalo.

Los Angeles, Cal. Leo Daft.

[Our esteemed correspondent evidently did not carefully consider the following paragraph which preceded the one to which he refers:

"The Buffalo *Commercial*, of Wednesday afternoon, devotes more than two columns of space to pen pictures of a number of the electricians who attended the banquet given by the Cataract Power & Conduit Company. Many of the items are so interesting that we reproduce them here."

The item was one of a score or so copied word for word and credited, as will be seen, to the Buffalo *Commercial*. The Electrical World recognized in these paragraphs a good and prompt piece of journalistic work on the part of the *Commercial*, as well as a particularly neat compliment to the electrical men who gathered to celebrate so important and historical an occasion, and as such was glad by republishing them, to show on behalf of its readers its appreciation of the good intentions of the *Commercial*. Neither the *Commercial* nor any other of the Buffalo papers printed paragraphs regarding any of the guests except those devoted to electrical pursuits, which was an added reason for The Electrical World's appreciation.—Ed.]

Qualitative Mathematics.

To the Editor of The Electrical World:

Sir:—With reference to Mr. Wolcott's letter, contained in a recent number of your journal, I would say that I have no especial desire to furnish an example of what Dr. Holmes has called "the hydrostatic paradox of controversy," or to balance scientific arguments against red-herring stories and wilful perversion of my remarks. With what follows, therefore, so far as I am concerned, this discussion will end.

With regard to the use of the term "qualitative," I would say that mathematics have hitherto dealt chiefly with quantity, and hence it seems to me that no very acute perception should be necessary to see that when I called this developed dimensional mathematics "qualitative mathematics," I did so in order to distinguish it from the earlier branches, since it is a branch of mathematics which deals with the qualities of substances. In like manner distinction was made between *qualitative* and *quantitative* analysis, when quantitative chemical methods began to come into use, though previously there was but one analysis.

The apparent discrepancy pointed out by Mr. Wolcott was ingeniously derived by him in the following manner: He takes one equation out of a chain of proof, in which equation there is an obvious misprint, a letter being omitted, as may be readily seen by comparing the previous and subsequent equations. When I say that attention was called to this misprint (The Electrical World, page 740, June 29, 1895), and yet Mr. Wolcott finds it necessary to rest one of his principal contentions upon it, no better proof of the poverty of his argument can, I think, be offered.

As regards Mr. Wolcott's point about the 10 fundamental units, I confess that I fail to see any discrepancy. As I said (The Electrical World, page 739, June 29, 1895), and as Mr. Wolcott correctly quotes me, we have 10 fundamental units, length, time, and eight others. They are fundamental so long as we cannot express them in terms of one another. When, however, we know the nature of electricity, magnetism, inertia and gravitational attraction then we can reduce the fundamental units to three, *i. e.*, length, time, and a new unit, that of force. There will then be three fundamental units, and the other eight units, being no longer fundamental, may be called quasi-fundamental. I fail to perceive any discrepancy in this.

The mathematical work is as follows: Ten minus two = eight, and eight plus three = eleven. It will be observed that it is purely arithmetical, and is generally considered quite simple; in fact, I would not insert it but for the fact that Mr. Wolcott thinks that there is a discrepancy somewhere.

Mr. Wolcott also finds fault with the fact that I used *force* as the third fundamental unit in my first note and now use *work*. Surely but a very elementary knowledge of the subject is required to enable one to see that it makes absolutely no difference which is used, for force times length equals work, and length is already one of the three fundamental units chosen. In my first note I used *force*, because it seemed to me the more natural idea, and length, time and force are the three fundamental quantities used by Newton in his laws of motion. In my later paper I use work in deference to the custom of of the more recent German writers, such as Hertz and Ostwald on dynamics. Either term is correct.

While, however, the above remarks will serve to show the invalidity of Mr. Wolcott's objections, there may remain some electricians still unconvinced as to the value of the method. That its power and importance may be more fully appreciated I shall now give an actual practical application to a well-known physical phenomenon, and shall show how easily, by this method, results may be obtained from what appear almost absurdly insufficient data.

Let us suppose that a stretched string is handed to two students and they are desired to answer the following question:

"A string is made of a material twice as dense, is half as thick and five times as long. With what force must it be stretched so as to vibrate twice as fast?"

Neither student is supposed to have any acquaintance with the physical phenomena involved.

One student may decide to work it out by the usual dynamical methods. Before he can do this, however, he must know whether the longitudinal displacement is concerned, and whether the tension may be considered as uniform through the whole length of the string during the vibration. Or he may decide to work the whole thing out experimentally. While he has gone to look up the necessary apparatus the other student, whom we shall suppose to have a knowledge of dimensional formulas, makes the following experiments:

1. He tightens up the string and notes that the period is changed.
2. He shortens the string and notes that the period is changed.
3. He doubles and twists the string and notes that the vibration is different from that of a single string of the same length.

He has now finished his experiments. He does not even need to note whether the vibration was increased or decreased by his manipulations. The first experiment shows him that the period is affected by change in the force applied, the second that it varies with the length, the third that it changes with the mass, but, since the vibration period is different, though the length and force are constant, that it is the inertia per unit length that makes the difference.

He may now write down, "Period is a function of

$$(L\,M\,L^{-3}, M\,L\,T^{-1}),$$

where L represents the dimensions of length, M those of quantity of inertia, and T those of time."

The period of vibration is the number of vibrations divided by the time, and its dimensions are therefore T^{-1}.

Then $T^{-1} = L^{x} \times M^{y} L^{-3y} \times M^{z} L^{z} T^{2z}$.

Solving, we get

$$x = -1,\ y = -\tfrac{1}{2},\ z = +\tfrac{1}{2},$$

whence, period of vibration varies as

$$\frac{1}{\text{length}} \sqrt{\frac{\text{force}}{\text{inertia per-unit length.}}}$$

We thus see that by the most simple, and apparently the most absurdly insufficient experiments, we have derived sufficient data to solve a complicated physical problem (how complicated may be seen by referring to any work on physics). The only difference between this result and that obtained by the other methods is that we lack a knowledge of the constant involved, but since we are only investigating the *nature* of the phenomenon (whence the term "Qualitative Mathematics"), and not looking for absolute numerical results, this is not necessary. It tells us the number of times the force must be multiplied, which was what is desired.

To the members of what we may call, in honor of its founder, the Wolcott, or red-herring story, school of scientific controversy, this may not appeal. But to those who desire to know whether this method has any value, I believe that the above example will be conclusive. What I have done has been to extend this method, by the introduction of the quantities concerned with electrical, magnetic, inertia and gravitational attraction phenomena, and more recently, by the separation of the dimensions of length along the different axes (following Mr. Williams in this, though with considerable modifications), and by the introduction of an operator which is needed to show the relative position of the quantities involved. The experiments confirming the results obtained will be published in due time. The work has been going on now for more than a year, and some of the experiments have been finished.

Allegheny, Pa. Reginald A. Fessenden.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES

COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Calculation of the Iron Losses in Alternators. BEHN-ESCHENBURG. *Elek. Zeit.*, Jan. 14.—A short article reducing a formula for calculating the hysteresis losses in alterators of the Klimenco, Mordey or Stanley type, in which the field poles revolve opposite a stationary armature; the question arose how to calculate the hysteresis losses in the iron ring outside of the armature. In his final formula he shows that the loss is C times as great as though the ring had been magnetized to complete saturation, C being easily calculated from the dimensions and is about 0.7.

Alternator.—L'Elec., Jan. 2.—A brief, illustrated description of the Blondel alternator in which both the field and armature windings are stationary, the only movable part being a massive iron spider.

Alternator. GUILBERT. *L'Eclairage Elec.*, Jan. 9.—A long article describing and discussing with the aid of curves and data the large flywheel diphase alternator of Hutin and Leblanc, of 250 kilowatts; he gives the details of the results obtained in running them in parallel; good illustrations of the alternator and the transformer are given.

Unipolar Machine. ANTHONY. *Elec. Eng.*, Jan. 27.—A reply to the article noticed in the *Digest* last week, showing how the theory of cutting lines of force explains the reason, and adding an explanation of the generation and disappearance of the lines of force in a ring-form of transformer.

Repairs of Electrical Machinery. HARRIS. *Amer. Mach.*, Jan. 28.—A continuation of his article describing, with the aid of illustrations, the windings of the Gramme ring armature.

Commutator Troubles and Their Remedy. HUTCHINGS. *St. Ry. Jour.*, February.—A brief communication, giving general hints of a practical nature.

LIGHTS AND LIGHTING.

Deposit of Carbon in Incandescent Lamps. POPOW. *L'Eclairage Elec.*, Jan. 23.—A description accompanied by illustrations taken from photographs of peculiar deposits from filaments which make a spiral or coil of a number of turns near the top of the lamp; the deposit in these is by no means uniform, but is in the form of a band following the general shape of the filament as though it were a sort of shadow; he thinks it confirms the opinion of the American Prof. Antoni (Anthony?) who thought that the deposit of carbon on the glass was caused not only by the vaporization of the carbon due to the high temperature but also to the electrical forces carrying the particles of charged carbon to the surface of the bulb due to a difference of potential between the filament and the bulb; on this assumption the bands could be the geometric loci of the minimum distances between the filament and the interior surface of the bulb.

Resistance of the Electrical Arc. FRITH and RODGERS. *Proc. Lond. Phys. Soc.*, December.—A reprint in full with three large plates of their Physical Society paper, read last May.

Comparative Tests of Different Systems of Lighting. JOLY. *Eng. News*, Jan. 28.—An abstract of a recent paper before a gas institute giving the results of photometric tests for the usual illuminants; the incandescent electric light is at one end of the table as the most expensive, and the electric arc in large lamps at the other end as the cheapest; next to the arc light is the Welsbach burner with coal gas, and next to the incandescent light is the ordinary gas burner.

Incandescent Lamp Improvement. CLEGG. *Elec. Eng.*, Jan. 27.—He seems to think that improvements due to the use of metallic oxides of the rare earths are not to be looked for, and that the only material suitable is carbon, the more graphic the better; the more homogeneous and solid and the more even and uniform the surface, the greater will be the efficiency and length of life at a given candle-power.

Lighting Contract for St. Louis.—Elec. Jour., Jan. 15.—A reprint of the specifications for public lighting, embracing 7000 arcs and 4000 incandescent lights.

POWER.

Efficiency of Worm Gearing.—Amer. Mach., Jan. 21.—An article giving the results of some tests with the Hindley form of worm as used on the Sprague elevator; there are two worms which are balanced against each other's end thrusts, thereby obviating the end bearing thrust; the efficiencies for various loads are given in the form of a curve, and are those for the entire elevator—that is, between the electricity consumed and the weight lifted; for the greater weights the curve approaches the horizontal at about 78 per cent, from which it is supposed that the efficiency of the worm itself is scarcely less than 90 per cent.; a smaller curve for a common worm gives 66 per cent. for the total efficiency. Particulars of further tests on worms of different pitches are promised.

Mining Plant. SPRAGUE. *Eng. & Min. Jour.*, Jan. 23.—A brief, illustrated description of the plant of the Davis Coal & Coke Co., West Virginia; this is the first company in that region to adopt electricity; the power is used at present for coal cutting and for the operation of five elevators and conveyors.

Mining Plant.—Eng. News, Jan. 21.—A note stating that a central light and power station for coal miners' use is said to be planned for Jackson County, O., supplying 15 mines in one district and 14 in another.

Central Station Economics. ABBOTT and DOMMERQUE. *Elec. Eng.*, February.—A very long article of 185 pages on the subject of power production, coal, etc.

Selection of a Power Plant. WAGNER. *Rose Technic*, January.—A short article of a general and somewhat elementary nature, discussing briefly the influence of the conditions on the selection of a suitable power plant.

Growth of Power Transmission. MCGHIE. *Elec. Eng.*, Jan. 27.—Graphical representations of the figures given in his recent article noticed in the *Digest*, Jan. 23.

Falls of St. Anthony Transmission.—Elec. Eng., Jan. 27.—A brief description of this proposed plant.

Rotary Engine.—Sc. Amer., Jan. 30.—An illustrated description of the Brambel or Sleepy Eye engine, about which there has been considerable excitement recently in the daily papers; it appears to be simply a modified form of the ordinary rotary engine.

TRACTION.

Three-Phase Traction at Lugano.—L'Elec., Jan. 9.—A short description, with some data, of the line at present in operation in Switzerland, to which references have frequently been given in these columns.

Railway Statistics in the United Kingdom.—Lond. *Elec.*, Jan. 22.—A supplement in the form of a table giving data and statistics concerning the roads in operation and in progress of erection. There are now about 19 electric railways as compared with 119 central stations; 12 are in progress as compared with 7 lighting stations; 51 are under consideration as compared with 12 lighting stations. Of all of the 19 lines in operation no two are strictly alike; the only definite systems not represented are the surface knob, closed conduit system and the three-phase trolley; the total length is 110 miles of track with 300 cars, of which 210 are motor cars or locomotives. The subject is discussed in the leading editorial.

Mechanical Traction in Paris.—L'Eclairage Elec., Jan. 16.—A report of some length of a long discussion at the International Society, besides some descriptions of vehicles; it is largely of local interest only.

Heavy Railway Service in California.—St. Ry. Jour., February.—A brief description of a three-mile line near San Francisco. Standard steam railway cars are used, and the general character of the equipment is like on the N. Y., N. H. & H. R. R., which was used as a model, except that the motor cars are equipped with four G. E. 1000 motors; the motor cars of the trains are a composite baggage and passenger car; there are two trolley poles to each car, only one of which is used at a time.

Trolley Wire Attachment for a Lift Bridge.—St. Ry. Rev., Jan. 15.—An illustrated description of the device used on the Van Buren Street bridge in Chicago; one end of the trolley wire is secured to the far end of the bridge, while the other end passes over a winding drum, to take up the slack as the bridge is lifted.

Dynamometer Car.—St. Ry. Rev., Jan. 15.—Details with dimensions of the car recently described by Bowen in the paper read at the St. Louis convention.

Continuous Rail. RAYMOND. *St. Ry. Jour.*, February.—A history and general discussion of the problem of the continuous rail.

Transportation Over the Brooklyn Bridge.—St. Ry. Jour., February.—A long, well-illustrated description of the transportation system, including a brief description of the electrical portion.

Toledo.—St. Ry. Rev., Jan. 15.—A well-illustrated description of the power house.

New London.—Elec. Eng., Jan. 27, and *St. Ry. Jour.*, February.—A brief illustrated description of the new power house.

Geneva.—St. Ry. Jour., February.—A brief, illustrated description of the electric line.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Small Lighting Plant.—Lond. *Elec. Rev.*, Jan. 22.—A brief description from the French of a very small private plant, which is working with entire satisfaction. There are 25 lamps, only five or six of which are burning at a time; a ¼-hp gas engine is used in connection with the accumulators of 85 available ampere-hours, the accumulators being charged in 10 hours for three days' use; the total cost of the plant was only $440.

Budapest. MOUTIER. *L'Eclairage Elec.*, Jan. 16.—A long, illustrated description, including details, of this alternating-current station, in which a single phase current of 3000 volts is used, with individual transformers.

Malta.—Lond. *Elec.* and *Elec. Rev.*, Jan. 22.—An illustrated description of the lighting plant of 275-kw capacity; the usual alternating-current system is used.

Circuit-Breaker.—L'Eclairage Elec., Jan. 9.—An illustrated description of a device to replace fusible wires.

Central Stations vs. Isolated Plants.—Eng. Mag., Feb. 7.—A reply to the recent article on whether central stations are doomed, see *Digest*, Dec. 12. He investigates that author's assumptions and gives a practical analysis of the comparative costs of current in isolated plants and central stations; he comes to the conclusion that isolated plants are seldom charged with any part of their share of taxes, insurance, etc., and that large portions of the management, etc., are charged to other accounts; that the first cost of the isolated plant is actually less than of the central station, in the items of boilers and conductors only, and that the isolated plant is more expensive in the items for engines, dynamos, real estate and every other item; the isolated plant cost less to operate only in the items of boiler-room wages, and possibly water, advertising, metering, and taxes, the cost being greater for management, accounting, repairs, coal, insurance, depreciation, etc.; that the first cost is practically the same in proportion to the current, but if all the expenses are included, the cost of operation for the isolated plant is far greater; he concludes that in the future an isolated plant will be as much of a curiosity as an isolated plant for gas lighting would be to-day.

Electric Plants in Small Towns.—Eng. Mag., February.—A short abstract from a German journal, in which warning is given to authorities of small towns against the too hasty installation of local lighting plants; most towns are already supplied with gas works, and there must be active competition in consequence; the character of the place should always be taken into careful consideration; if there are many factories the demand for light would be likely to be greater, but in an agricultural town it is likely to prove a disastrous investment.

Electricity in the Government Printing Office.—West. Elec., Jan. 30.—An abstract of the reports of Reid and Tapley on the operation of the plant, which supplies 5000 incandescents and 127 motors.

WIRES, WIRING AND CONDUITS.

Long Spans for Aerial Lines. PIERARD. *L'Elec.*, Jan. 16.—It is a well-known fact among constructors of overhead lines of phosphor-bronze wire that long spans are more stable than short ones; this is easily shown in practice, but is difficult to prove algebraically, but by the aid of figures from a table of Cloeren he deduces some curves which are given and which show that the stability increases with the length of the span; he concludes that it is therefore an error in economy to limit the span to 60 or 100 metres like those for iron wires; to adopt spans of 200 metres (656 feet) as compared with 100 metres requires increasing the height of the poles only 1.90 metres (about 6 feet) which increases the price of the poles about 40 per cent., as only half the number would be required the total cost would be only 70 per cent., which means an economy of 30 per cent. on the poles; the saving in insulators, supports, transportation of materials and erection would be 50 per cent. This applies to bronze wire of 30 per cent. conductivity and a breaking strain of 80 kg per square mm, which is the wire usually used for telephone lines.

Poles for Line Wires.—Elek. Zeit., Jan. 14.—An editorial article on the desirability of prolonging the life of such poles, showing that the natural condition of the wood has a greater effect than all subsequent treatments to preserve them where they enter the ground; the condition of the earth in which the tree is grown has a great effect, and it is thought that it might be possible to influence the growth of the trees favorably; in a recent article by Petersen in a Scandinavian journal he calls attention to wood which is several hundred years old and is still as fresh as though it were new; in those early days it was customary to prepare the wood to be used for such purposes in the Summer one year before the tree was to be cut down, by cutting off the bark for 10 to 12 feet; the result of this is that the trunk, and especially the lower part, becomes more rich in resins, which increases its resistance to decay; such a process would increase the life of telegraph poles perceptibly without increasing their cost.

Wiring Accessories. HUNDHAUSEN. *Elek. Zeit.*, Jan. 14.—A reprint of the first part of a long, well-illustrated paper, describing a new system of wiring accessories devised by Siemens and Halske to comply with the new rules adopted in Germany; the devices are fully illustrated and include joints for stranded cables, fuses which are not interchangeable, fuses in which the arc is prevented mechanically, and some other devices.

Concentric Wiring System.—Lond. *Elec.* and *Elec. Eng.*, Jan. 22.—An illustrated and detailed description of the Kosmo system; the conductors are flexible and are covered with lead; the main cables lead to distributing centres on each floor, from where the section cables radiate.

Subway System for Baltimore.—Eng. News, Jan. 28.—An abstract of the recent report of Hill noticed before in these columns; it includes the table of the estimates of cost of the subway system with different forms of ventilation.

ELECTRO-PHYSICS AND MAGNETISM.

Röntgen Rays.—Proc. Lond. Phys. Soc., December.—A large number of abstracts of articles, many of which have already been noticed in these columns; most of them are of special interest to the physicist; the greater number are from *Comptes Rendus*. PULUJ found that substances which fluoresce most brightly under the visible cathode rays, give off the greatest amount of Röntgen radiations. The Röntgen ether rays originate in the bombardment by negatively charged molecules from the cathode and in the abrupt loss of charge by these; there are also invisible radiations from a screen of sulphide of calcium. Cathode rays striking a plate of mica give off Röntgen rays and fluorescent light from both of its surfaces. MUELLER found that rays seem to go around an opaque metallic object, like light in transversing smoky air; they can scarcely be hyper-ultra-violet light because air becomes very opaque as the wave length diminishes, but it is very transparent to Röntgen rays. MAURITIUS also found that the rays are bent around objects; he suggests that there may be another kind of ray present in his experiments. GALITZIN and KARNOJITZKY endeavored to find the source of rays, but appear to have gotten no definite results; sometimes the fluorescent patch was very large, while the centre or radiation still seemed to be very well defined; there also appeared to be secondary centres which are not associated with visible fluorescence. WINKELMANN and STRAUBEL found that if the rays traversed glass, then a sensitive film and then strike fluorspar, the film is affected 100 times as rapidly as without the fluorspar; if tin foil or paper is interposed between the film and fluorspar, there is no such acceleration and it is therefore not due to reflected Röntgen rays but to a transformation into "spar-rays."

X-Ray Experiments. SALOMONS. Lond. *Elec.*, Jan. 22.—A summary of the experimental results which he obtained and described in two previous papers; they are as follows: "A strong magnetic field stops the passage of the current in the tube. With a 'shadow cross' tube, a very small magnetic field near the cathode causes the shadow to disappear. A bar magnet (say 9 x 1 x ½ inches, will produce the same result when held anywhere near the side of such a tube. If the magnet is too weak, then the shadow will not quite disappear. If a pole of such a bar magnet be held axially to the tube and the pole placed to one arm of the cross, then on rotating the magnet in a circle (*i. e.*, its axis describing a cylinder) then the cross will rotate also, either following or advancing before the pole, according to the pole applied; in other words, attracted or repelled. The bar magnet also affects the 'focus tube,' rendering the X-ray results far less when a pole is near the tube. In a suitably adjusted magnetic field a Crookes tube exhibits only the usual vacuum tube phenomena. Further, the ordinary radiometer ceases to act in a strong magnetic field." He concludes that cathode rays rank in the same category as the ordinary discharge in rarefied gases; he thinks the rays are similar in character to the ordinary rays but of shorter lengths.

Röntgen Rays. SELLA and MAJORANA. *L'Eclairage Elec.*, Jan. 2.—A translation in abstract from the Italian, of a paper in which they endeavor to show a bending of the rays in vacuum by a magnetic field in a long tube, and believe it indicates a method of finding a lower limit to the velocity of propagation of these rays. In another abstract following this they discuss the action of the rays on the disruptive discharge in the air. In another they discuss their action on the nature of the discharge.

Dark Light. LE BON. *Proc. Lond. Phys. Soc.*, December; abstracted from the *Comptes Rendus*, 122, page 1054.—When a thin sheet of copper and one of lead are exposed to an arc light 20 cm distant, for one hour, then allowed to cool, and if then a sensitive plate and the object, such as a photographic negative, be placed between the two unexposed sides, the object being between the sensitive plate and the copper, with a film of glass or celluoid between, a perfect image will be developed after six hours; heat produces no such effect; black paper between the metal plates and the arc lamp prevents the effect; sunlight does not always succeed; an arc lamp will photograph a hand in one hour through one cm of deal; animals can be photographed by some kind of invisible fluorescence, the rays of which do not traverse metals.

Radiation. DORMAN. Lond. *Elec. Eng.*, Jan. 22.—The beginning of a reprint of the presidential address before the Northern Society of Electrical Engineers; it is very general in character and treats of waves, vibrations, etc.

Surface Action of Discharge Knobs. SWYNGEDAUW. *L'Eclairage Elec.*, Jan. 9.—A reprint of the Academic paper noticed in the *Digest*, last week.

Magnetic Viscosity. MARTENS. *Wied. Ann.*, No. 1; noticed briefly in the Lond. *Elec.*, Jan. 22.—He investigates this property in samples of iron in the form of circular discs, as they can be made to revolve in the earth's horizontal field; this shape may be used for both the ballistic and the magnetometric methods. He finds that the hysteresis loss is independent of the velocity between 2.5 and 200 per second; it is less in steel, nickel and hard iron, than in soft iron; when the disc is suddenly stopped the magnetization slowly increases (this applies to the weak field of the earth.)

Energy Used in the Magnetization by Oscillating Discharges. KLEMENCIC. *L'Eclairage Elec.*, Jan. 2; translated from the *Wied. Ann.*, No. 58, page 49.—He shows that it is probable that the loss from hysteresis in soft iron is greater for oscillations than for slow alternations; in steel and nickel the value is the same for both.

Constants of the Earth's Magnetism. MOUREAU. *L'Eclairage Elec.*, Jan. 23.—The absolute constants on the 1st of January, at Parc St. Maur, near Paris.

Calculations in Electromagnetism. VASCHY. *L'Eclairage Elec.*, Jan. 8.—A reprint of an Academic paper of a mathematical nature.

Electric Waves. DRUDE. *Wied. Ann.*, No. 1; abstracted briefly in the Lond. *Elec.*, Jan. 22.—The article is considered, editorially, as being of some importance; he formulates a true and complete theory of the working of the Lecher wire system; the main conclusion of the somewhat lengthy paper is that waves reflected by a bridge lose in amplitude and in phase, the loss being determined by the ratio of the length of the bridge to that of the wave.

Absorption of Electric Waves by a Terminal Bridge. BARTON and BRYAN. *Phil. Mag.*, January.—A reprint of the Physical Society paper noticed in the *Digest*, Dec. 12.

Dielectric Constants. ABEGG. *Wied. Ann.*, No. 1; noticed briefly in the Lond. *Elec.*, Jan. 22.—He discusses dielectric constants at low temperatures, and shows that they all increase as the temperature falls, approaching the high capacity of water; the temperature coefficient is especially high for high constants when the divergencies from Maxwell's law is greatest.

Action of Röntgen Rays on a Jet of Steam. RICHARZ. *Phil. Mag.*, January; abstracted from the *Wied. Ann.*, No. 11.—He shows that the rays increase the condensation in the jet of steam and describes the experiment.

Magnetic Force Acting on Moving Electrified Spheres. SCHUSTER. *Phil. Mag.*, January.—A mathematical discussion of the subject.

X-Rays Apparatus. WILLYOUNG and SAVEN. *Elec. Rev.* and *Elec. Eng.*, Jan. 27.—The first part of a reprint in abstract of a recent Franklin Institute paper describing the apparatus, which was noticed in THE ELECTRICAL WORLD, Dec. 26, and including some of the results of their observations made in developing an apparatus for practical work. The induction coil is preferred to the Tesla apparatus; one of the features is an adjustable condenser; they also tried a condenser in parallel with the primary, which seems in many cases to greatly increase the discharge; the larger the primary voltage the smaller the condenser capacity; they obtain the best results with 3600 to 4800 interruptions per second; the brush in their water-break wheel should be positive; 15 to 20 amperes have been broken with this wheel for a considerable time without overheating. With a given coil or tube the shortness of exposure is not exactly inversely as the number of breaks, and often far from being so; it appears that the energy of the radiation per break is a function of the rapidity of the breaks; they believe that it is a matter purely of the time constant of the coil; a tube is limited to the amount of energy which it can dissipate, and therefore whether the breaks are slow or fast, the actual time of the exposure remains practically the same; this applies to the photographic plate, but for the fluoroscope rapid breaks are required; the rate of break must not be too great as the iron may not have time to magnetize and demagnetize, the result being an alternating instead of a direct discharge, which blackens the tube and injures it generally; they doubt whether, with any size of coil, a rate greater than 5000 per minute should ever be used.

Radiagraph Showing Arterial Circulation.—Elec. Rev., Jan. 27.—A reproduction (which has been touched up) of a radiagraph made at a New York hospital, showing the arterial circulation in the fore-arm; it was thought that there was an unusual supply of lime salts in the blood.

Electrification of Air by Röntgen Rays. KELVIN. BEATTIE. SMOLAN. *Science*, Jan. 22.—A reprint, with illustration, of their recent paper.

ELECTRO-CHEMISTRY AND BATTERIES.

Development of Electro-Chemistry. PERGER. *Zeit. des Oester. Ing. u. Arch. Vereins;* noticed briefly in the *Eng. Mag.*, February.—A very full review of the development of electro-chemistry during the latter portion of this century.

Electrolyzers for Laboratories.—L'Elec., Jan. 16.—A French translation of the descriptive article with illustrations which was noticed in the *Digest*, Dec. 19.

Efficiency of an Electrolytic Cell. HURTER. Lond. *Elec.*, Jan. 22.—A brief abstract of a recent paper giving the results of his investigations into the energy efficiency of an electrolytic cell; he claims to have solved one of the problems connected with applied electro-chemistry, for hitherto the current efficiency of any cell containing a mixed electrolyte has been determinable only by experimental trial; some of his statements are thought to be controversial in character, as they reflect on the practicability of certain processes.

Reduction of Wolfram in the Electric Furnace. DEFACOZ. *L'Eclairage Elec.*, Jan. 9.—An abstract of an Academic paper in which he describes the reduction of the mineral wolfram in the electric furnace by means of carbon, the metal produced being pure.

Production of Hypochlorites and Chlorates. OETTEL. *Amer. Jour. of Sc.*, February; an abstract from an article from the *Jour. Chem. Soc.*, September.—He investigated the electrolysis of solutions of potassium chloride; with neutral solutions he finds that the main product is hypochlorite, 83 per cent. of the active chlorine existing in this form, while 17 per cent. existed as chlorate; adding alkalies increases the chlorate, as does also raising the temperature; diminishing the density of the current at the cathode favors the reduction of the hypochlorite, the effect being greatest in a strong solution, either neutral or slightly alkaline; no diaphragm is necessary in the alkaline solution.

Separation of Nickel and Copper and Recovery of Precious Metals. ULKE. *Eng. & Min. Jour.*, Jan. 30.—A brief review of the various electrolytic methods which have been proposed for separating nickel and copper in matte and the recovery of the precious metals from them; one of the methods is for determining the copper and nickel in smelter matte.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Waste Space Around the Needle of the Galvanometer. GRAY. *Phil. Mag.*, January.—A reply to the recent criticisms of Holman (see *Digest*, Dec. 21, 1895; also Dec. 12, 1896), who thought that he had found an error in statements by the present author. Examining the matter more closely Gray found that no correction of his former statement was required and that Prof. Holman had arrived at an erroneous result.

Tesla Apparatus. SVILOKOSSITCH. *L'Elec.*, Jan. 2.—A brief, illustrated description from a German paper of a simple form of Tesla apparatus in which air instead of oil is used for the insulation of the coils.

Measuring Electrolytic Conductivity. STROUD and HENDERSON. *Phil. Mag.*, January.—A reprint in full of the article abstracted in the *Digest*, Nov. 28.

Apparatus for the Study of Electric Waves. BOSE. *Phil. Mag.*, January.—A reprint of his British Association paper, which was noticed in these columns a number of months ago.

Universal Photometer. BLONDEL and BROCA. *L'Eclairage Elec.*, Jan. 23.—An illustrated description of a new photometer devised by them, based on the "cat's-eye" method of Bouger and Cornu and with which all the photometric measurements can be made with a single apparatus and a precision at least equal to that of the best instruments; it is applicable as well for scientific researches as for practical measurements. It is provided with a binocular eye-piece; it is said to be remarkably sensitive; they describe how intensity, brightness, illumination and flux can be measured and how it may be adapted to all kinds of measurements, as it is readily transportable when used with a small amyl acetate lamp; an accuracy of half a per cent. is readily obtained provided the standard can be relied on; it is at least as sensitive as the device of Lumiere and Brodhun and this they think is due to the binocular eye-piece. The description does not admit of being abstracted.

Standardized Measuring Apparatus. ARMAGNAT. *L'Eclairage Elec.*, Jan. 9, 16, and 23.—A continuation of his series of articles forming an up-to-date treatise on the subject; he discusses the subject of suspension, the antagonizing force, damping and coils; voltmeters, ampere-meters, wattmeters, and ohmmeters, including illustrated descriptions of the principal forms.

High-Potential Accumulators. ZEHNDER. *Wied. Ann.*, No. 1; noticed briefly in Lond. *Elec.*, Jan. 22.—Practical advice on the treatment of such accumulators; they should not be left coupled up in series for any length of time nor should they be left disconnected; when not in use the best way is to leave them connected in parallel.

Hookham Meter. Lond. *Elec.*, Jan. 22.—An illustrated description of recent improvements in this meter, all of which are in the structural and mechanical details; the calibration curve is given and shows a close approximation to the theoretical straight line from $\frac{1}{30}$ of the load upwards, and has a range of about 400; a good illustration is given.

Interferential Induction Balance. BARUS. *Amer. Jour. of Sc.*, February; a description of a device capable of a variety of applications in relation to alternating currents and magnetic induction.—The fundamental idea of the apparatus is briefly as follows: "Let the slender iron cores of two identical helices be placed at right angles to each other, in the same (horizontal) plane and at like distances from the point of convergence. Let the distant ends of the iron cores be rigidly fastened, while the other ends are free to move (expand and contract) in the direction of the axis. Then it is possible to adopt Michelson's interferential refractor in such a way that the fringes are visible whenever the excursions of the free ends of the cores are either zero or vibrating in the same phase, amplitude and period, to and from the point of convergence. The fringes vanish

more or less fully for all other phases." Several applications are described and the results given. With about 100 volts the arrangement ought to indicate the retardation along more than a single knot of wire or high capacity.

Motion of a Damped Galvanometer Needle. LENDI. *Rose Technic*, January.—An article of a mathematical nature discussing the motion of a small magnet vibrating in a resisting medium, like air, the object being to find the way in which the needle moves for different relations between the coefficients of the equation of motion, and to find the condition which will bring the needle to rest in the shortest time; the conclusions cannot be given briefly enough to be abstracted here.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Submarine Telephone Cable. BRYLINSKI. *L'Eclairage Elec.*, Jan. 2 and 9.—He discusses the difficulties in devising such a cable, and offers a study of the question, examining the different methods and endeavoring to show that some of them can never be successful; the article is largely mathematical in character. His conclusions lead him to believe that the best direction in which to make an attempt is to construct the cable with a single conductor of silicate-bronze and of large diameter, insulating it with a small amount of gutta percha, covered with jute and tape, using an armor only for depths less than 100 metres; such a cable would contain 500 kg of gutta percha per nautical mile, 1300 kg of copper, of a resistance less than 0.4, and of a breaking strength of at least 42 kg per sq mm; such a cable, 378 knots long, might enable telephonic communication to be carried on between Marseilles and Algiers, and probably even between Paris and Algiers; the cost would not be so high as to be prohibitive, but in any case, even if telephonic transmission were not possible, it would enable the speed of telegraphic messages to be greatly increased; it would cost only about four times as much as the present cable between those countries.

Accumulators in Telegraphy. MONTPELLIER. *L'Elec.*, Dec. 26.—The conclusion of his descriptive article on the new installation in Paris; it includes complete diagrams of the connections, switches, etc.

Telephony. WEITLISBACH. Lond. *Elec. Eng.*, January.—A very long article, being a reprint of the first 110 pages of a revised edition of his long series of articles, which has been published in that journal; it is in the nature of a treatise on the subject of telephony and includes numerous illustrations.

Submarine Telephone Cables. MANCE. Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, Jan. 22; the conclusion of his presidential address.—Regarding telephone and fast speed cables, he states that we may reasonably hope that we are on the eve of substantial improvements in connection with the methods of submarine electrical communications, especially in fundamental alterations in the structure of cables; he thinks the day may come when a cable will be constructed which will make transatlantic telephony possible; the forms of cables which have been suggested are briefly described but not commented on. He also discusses briefly, electro-chemical developments and the Institution.

Pacific Cable. TAYLOR. Lond. *Elec.*, Jan. 22.—A brief comment regarding the cable proposed by S. P. Thompson, The present writer some two years ago made some experiments in behalf of a large company, the result of which did not warrant the assumption that any great increase of speed could be looked for by using distributed leaks, without the employment of a much greater battery power, the effect of leaks being to reduce the potential at the points of application, making the received signals relatively small; with a single core cable, having leaks connected to the armor, there are other means of meeting the difficulty, which would be preferred to using a double core cable; he believes that the Thompson cable would carry more traffic if the two conductors were used as two separate cables, than by using one to accelerate the speed of the other.

Amazon Cable. Lond. *Elec. Rev.*, Jan. 22.—A short article calling the attention to the inefficiency of the maintenance fund for this cable and questioning the sufficiency of the revenue.

Telephone. L'Eclairage Elec., Jan. 9.—An illustrated description of a telephone the object of which is to prevent the effects of high frequency alternating currents in the microphone; the microphone has two circuits which are acted upon by the voice, and which are traversed by alternating currents, differing from each other by a quarter of a phase; the receiver also has two magnetic circuits, so that the mutual inductions in their coils neutralize each other; there is only a single diaphragm.

Automatic Call for Telephones. L'Eclairage Elec., Jan. 23.—A French translation in part, with illustrations, of the article noticed in the *Digest*, Dec. 19.

Syphon Recorder. KELVIN system. *L'Eclairage Elec.*, Jan. 16.—An illustrated description of his new recorder; also of his meter.

Telephone Competition. DE LAND. *Elec. Eng'ing*, January.—A short quotation from a recent interview with Rodgers of the Topeka Telephone Company, in which he endeavors to show that it is not correct to assume that in the telephone business competition is the means to obtain a product at the lowest cost; he quotes his experience in that city.

Bell Telephone Business in the West.—West. Elec., Jan. 30.—Abstracts of recent reports of the Chicago and the Central Union, licensed telephone companies.

Party Line Telephone.—Elec. Eng., Jan. 27.—A brief, illustrated description of the new instrument of the Long Distance Company.

MISCELLANEOUS.

Destruction of the Phylloxera.—L'Elec., Jan. 2.—A note stating that the experiment recently made by an engineer of the Siemens & Halske Company to destroy the phylloxera on grape vines, by means of ozone generated by electricity, have given unfavorable results; the way in which the ozone was applied is not described.

Electricity for Crucible Fusions. LEEDS. Lond. *Elec.*, Jan. 22.—He discusses the question of the practicability of using electric energy instead of the direct heat from coal; in certain metallurgical operations electricity has properties which may render it able to compete with coal; the amount of heat generated is more easily and directly applicable and there is no ash or slag to contend with. He gives the amount of fuel consumed in melting iron or steel by direct heat, and a table showing the efficiencies in the various furnaces; if the electric furnace has an efficiency of 21.1 per cent. when turbines are used, or 63.4 when using coal and steam, it would be quite as economical as direct firing for all crucible heating; he then discusses whether this could be expected and makes some calculations based on the Cowles furnace, the net efficiency of which he finds is 32.5 per cent.; assuming water power, he shows that the electric process would have been cheaper than coal firing, the efficiency of the furnace being 32.5 per cent. instead of 18.1, an advantage in favor of electricity of 80 per cent; using steam the efficiency of the electric system need be raised only 67 per cent. to enable it to compete with coal used directly; he thinks it probable that it can. In conclusion he states that where water power is available the use of electric heat is considerably cheaper; where purity is of importance it is better than direct heating.

Deaths from Lightning. TURQUAN. *L'Eclairage Elec.*, Jan. 23.—An abstract of some statistics for France, which are said to be complete records of those killed by lightning during the past 67 years; those for the past 24 years are given in the abstract. Bondin found that for every one person killed there are three or four who are wounded; in the month of March the average deaths amount to 1 per cent.; in April, 3; in May, 7; in June to September, 30, 20, 31 and 15 respectively, while in October it was 12; most of the cases occur in fields and roads, but above all under trees; one out of four was killed while taking shelter under a tree; in a period of 30 years 1700 persons were killed under trees who would not have been injured if they had not taken refuge there. In France there have been eight deaths per 100,000 inhabitants and in Great Britain two.

Progress of Electricity.—L'Eclairage Elec.—A series of articles giving a summary of the progress in 1896. The issue of Jan. 2 contains an article by RAVEAU on electro-physics; Jan. 9, one by PELLISTER on applied electricity; Jan. 16, one by HESS on the same subject.

Foreign Import Duties on Electrical Machinery and Lamps.—Lond. *Elec. Rev.* and *Elec. Eng.*, Jan. 22.—A reprint of a table prepared by the English Board of Trade; it includes all the countries except Great Britain.

Animal Electricity. WALLER. Lond. *Elec. Rev.* and *Elec. Eng.*, Jan. 22.—Brief abstracts of the first of a course of 12 lectures on this subject.

Prizes.—L'Eclairage Elec., Jan. 16 and 23.—A list of the subjects for which prizes of $100 each are offered at the international exhibition at Brussels this year.

Electricity for Opening Safes.—Elec. Eng'ing, January.—An editorial notice of a case in which an arc of 50 volts with a current of 300 to 500 amperes was used to penetrate, in three to ten minutes, walls of safes three to six inches thick; experiments were made with a steel ingot which was easily penetrated with a hole from two to three inches in diameter and eight to nine inches long. (Nothing is said of the difficulty which burglars would have in getting such a current).

Electricity in Naval Life.—Elec. Eng., Jan. 27.—The conclusion of the reprint of his recently published pamphlet, the parts of which have been noticed in these columns; he discusses the direction of future progress, signaling at sea, and central stations.

Progress of Electrical Engineering in Germany.—West. Elec., Jan. 30.—A reprint of the article noticed in the *Digest*, last week.

Electricity. TESLA. *Elec. Rev.*, Jan. 27.—A reprint in full of his recent address at Buffalo; it is very general in character. He discusses the features of human intellectual progress in recent times, which chiefly interest the scientific man, the thinker and the reasoner; he refers to the influence of the artist; electricity has been one of the most potent factors in the elevating features which characterize modern intellectual development; he refers to the merging together of the various sciences or departments of research and the connection between different forces and phenomena; only a brief reference is made to high-frequency currents; the electric transmission of power is considered to be the most important industrial application. In referring to the direct production of electricity from carbon in a battery, he states that he does not think it will be as much of an advance as some seem to believe; he favors the mechanical generation and considers the probability of replacing the present generators by batteries as a very remote one; he has confidence in the development of a light storage

battery involving the use of chemicals manufactured by cheap water power, such as some carbide or oxygen-hydrogen cell; he refers to means for obtaining energy from stores which are forever inexhaustible without combustion or waste of any material, stating that he has had the matter under consideration for a number of years, and believing the problem will ultimately be solved; he thinks the realization of the idea is not far off; he refers to the possibility of the operation of engines on any point of the earth "by the energy of the medium" (presumably a misprint); but he adds that under the theoretically best conditions such a method of obtaining power cannot equal in economy and simplicity the conversion of the energy or running water into electrical energy; he has devised means for using for transmission E. M. Fs. much higher than practical with ordinary apparatus; he believes he will succeed in transmitting power without the employment of any connecting wire.

New Books.

DIE WIRKUNGSWEISE, BERECHNUNG UND KONSTRUCTION ELEKTRISCHER GLEICHSTROM-MASCHINEN. By J. Fischer-Hinnen. Third edition, 1897. Published by Albert Raustein, Zurich, Switzerland. 326 pages; 211 illustrations. Price, M. 10.80 ($2.70).

While there exist many good books on the principles and the theory of dynamo-electric machines, there are but very few works on dynamo calculation, and of these few none has so far treated the subject in an entirely practical manner. The volume before us, in admission of this fact, has been written upon the motto: "Aus der Praxis, fur die Praxis," but the author has tried, in a space of but 320 pages, to combine three things, Theory, Calculation and Design, and consequently could not do full justice to the most important and most needed subject: Practical calculation. The work, however, is a very creditable production, inasmuch as it contains a great amount of valuable practical information, enabling one experienced in dynamo design to determine for practical purposes certain dimensions and data of a continuous-current machine.

The book is subdivided into 11 parts: I. General theoretical deductions; II. Calculation of the armature; III. Calculation of the magnets; IV. Permeability tests; V. Dynamo graphics; VI. Brush-lead and sparking; VII. Constructive details; VIII. Description of actual machines; IX. Weight, size, and cost; X. Formulas; and XI. Tables. In Part I. is treated: Magnetism, electromagnetic induction, absolute and practical units, and conductor-resistance; in Part II.: Windings, armature-losses, changing one armature into another of different voltage, and calculation of a new armature; in Part III.: Methods of excitation, transmission of energy, rotation, electric braking, change of magnet winding for a different condition, and new magnet winding; in Part IV. the various methods and apparatus employed for permeability tests are described; in Part V. various practical problems arising in dynamo design are solved by graphical methods; in Part VI. the causes of sparking and the methods for its prevention are treated; in Part VII., which is the most complete one, practical formulas and data for the construction of dynamo-shafts, bearings, pulleys, armature-cores, commutators, brushes and holders, magnet frames, magnet spools, cable-lugs, binding posts, belt-tighteners, etc., are compiled; Part VIII. contains a collection of modern dynamos of Swiss manufacture, which are well illustrated by sectional views and reproductions of photographs; Part IX. gives approximate formulas for the weight of the various parts of a dynamo, tables of general dimensions of various common types, and data for the estimate of the cost; in Part X. the most important formulas given throughout the book are compiled in a more systematic manner for quicker reference; and in Part XI., finally, 13 tables for use in dynamo-design are given, such as wire gauges, hysteresis-factors, leakage-coefficients, key-ways, pulleys, etc. As an appendix there are attached four plates, containing dynamo-specification-blank, magnetization curves, types of bipolar and multipolar fields, and curves showing the dependence of weight upon output respectively.

The alphabetical index, comprising but 4½ pages, is decidedly insufficient, since for a practical reference book of this kind it is of the utmost importance to find quickly the information desired. Although the book contains a great amount of really good matter, the information is not proportionately divided among the various subjects, for, while for instance the mechanical details are very exhaustively, and in some cases even rather too minutely, treated, very little of practical value is said on the rational calculation of the armature and magnet windings. Furthermore, the subject matter is somewhat illogically arranged, it being expected in a treatise on practical design that the parts are taken up in their natural order as they are developed from the quantities given. Many of the data presented in the form of tests could have been reduced into a more tangible form so as to be ready for immediate practical use, instead of leaving it to the reader to draw his own conclusions.

Finally, the reviewer considers it a pity that the congress-notation is not adhered to in a modern book of this kind.

ELECTRIC TRANSMISSION OF POWER: By Dr. Louis Bell. Published by The W. J. Johnston Company, New York. Cloth, octavo, 488 pages, 229 illustrations and diagrams. Price, $2.50.

The literature of electric power transmission has consisted, until now, of scattered papers and descriptions of installations, published for the most part in journals and the transactions of societies, and practically inaccessible to the student, the engineer, or the possible investor seeking information and guidance. A great amount of this information has hitherto remained unpublished or has appeared in such a way as to be unavailable to any save the skilled electrician. It was Dr. Bell's design to collate the facts of experience, the results of the labors of engineers in all parts of the world, the theoretical considerations which underlie the successful installation of power-transmission plants, and to present them in such shape that they should be useful to all classes interested in this branch of electrical engineering.

The result is a most gratifying success from all points of view. The book is of value as a text-book, of the deepest interest to the practising engineer, and an authoritative and fair statement of facts worthy to be considered by those contemplating the exploitation of power transmission enterprises.

Perhaps the most striking characteristic of the book is its eminent practicality, and next to this its almost judicial fairness of attitude. The author has not ignored other methods of accomplishing the desired ends, nor has he insisted upon the applicability of electrical methods to all cases where power is to be transmitted, but he has discussed the relative merits of electricity and other agents for a great number of cases and shown what is best in each, besides laying down a number of general laws for the guidance of those seeking information on these subjects.

The book begins with a chapter on elementary electrical principles, which is almost classic in its simplicity, clearness and completeness. Here, as throughout the book, the physical ideas underlying the usual mathematical statement of electrical theory are used, to the exclusion of the formulæ of the text books, with the result that, for almost the first time, the conceptions of electric energy, ether strain and energy transformations are presented in language that the laity can understand.

This introductory chapter, while intended primarily as a representation of certain basic facts of electrical theory to those unfamiliar with the science, should not escape the attention of technical readers, since it is unique in its treatment of the fundamentals of electrical action.

A review of the methods of power transmission by other than electrical means gives a variety of exceedingly interesting data, and summarizes the conditions under which each finds its most efficient application.

Power transmission by continuous currents is treated in a single chapter, especial attention being paid to railway practice. The methods of distribution in use are described, and interesting conclusions drawn as to the usefulness of continuous-current distribution under certain conditions.

A chapter on the properties of alternating currents properly introduce the main subject: Power transmission by alternating currents under all conditions of phase-relations, voltage and distance, and the economic considerations drawn from the experience of the last few years.

The author has given a collection of data which cannot fail to prove immensely valuable to those undertaking power transmission work in the future. He has not attempted prophecy, but has treated his subject from the standpoint of the present, describing what actually exists rather than what has been planned, and furnishing an exhaustive commentary and criticism of the various examples of engineering considered.

The book is deeply interesting, not only by reason of the newness of its subject, but as well on account of a certain sprightliness of diction with which Dr. Bell has freshened otherwise dry places in his text.

The final chapter on the commercial problems involved in power transmission will commend itself to all seeking information on the subject as a very careful and well considered treatment.

The author can be congratulated upon having added a very timely and important contribution to the literature of electricity.

THE STREET RAILWAY SPIRAL is the name of a blue-printed pamphlet published by C. A. Alden, C. E., Steelton, Pa., intended as a pocket book for street railway track construction men. It is highly condensed, and gives, in addition to the methods of plotting spiral curves, examples of their application, and the necessary tables.

Improved Conduit Boxes.

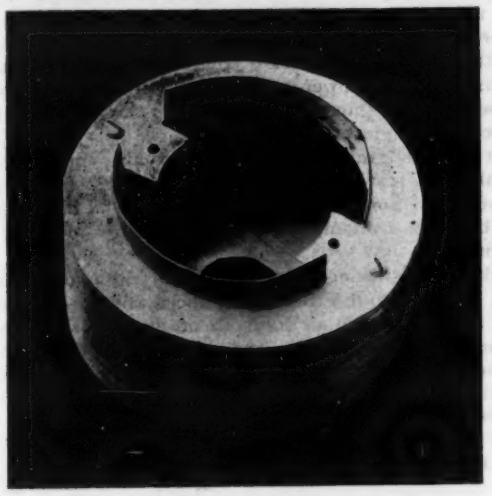
The qualities of cast iron for wall, outlet and switch boxes for conduit work has been the subject of important discussion by electrical engineers and contractors.

Such boxes have generally been made of cast iron with holes cut in for the insertion of conduit, and for the lack of something different or better have come into general use. The criticism which has been made of most boxes so far put upon the market has been that if the construction man desired to insert the conduit into the box at a different place than the hole provided he had either to break another hole in the box, have one drilled in, or finally discard the box altogether, or find a new one.

A further argument against cast iron boxes has been that many of them break while being placed in position and are often times left there by careless workmen.

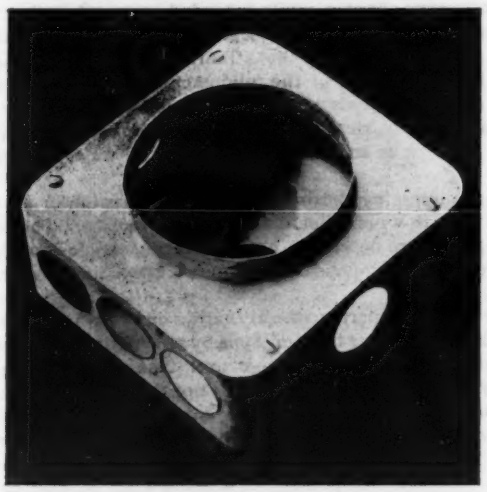
The Bossert Electric Construction Company, Utica, N. Y., alive to the fact that a better material and one which would be absolutely indestructible might be secured, and that a more convenient form of construction of

these boxes could be devised, has recently made a decided innovation in these goods, which bids fair to elicit the favorable opinions of those interested. All these forms of boxes are drawn from one piece of sheet



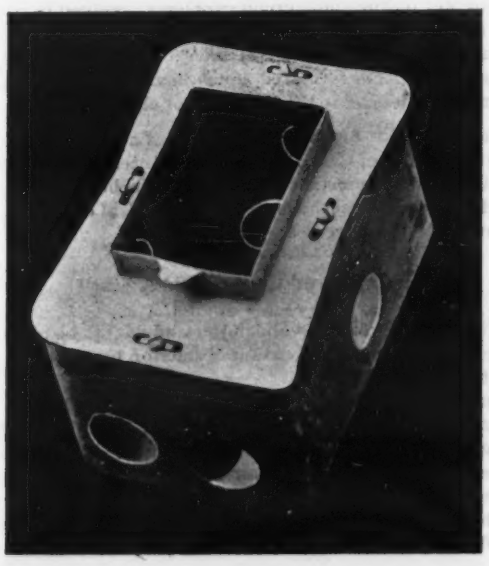
Switchbox.

steel. The boxes are provided with a number of holes in the sides and bottom which are securely plugged up again and guaranteed to render the



Outlet Box.

box water tight and fire proof, and should the workman choose to enter the box at a different point than that on which he had calculated he has but to



Outlet Box.

drive out the steel plug at that point. Holes are made for any size conduit and the boxes are heavily insulated.

This company also makes a special steel-drawn switch box for the Cutter switch, the Hart switch and the Gibbs switch, provided with holes in the same manner as above described, and claims that these boxes are the best, the cheapest and most convenient of any now upon the market.

This company also makes steel-clad slate-lined junction boxes and distributing boxes of every description, marine and underground boxes, and in fact any box which an electrical contractor may be required to furnish.

Owing to increase in business the company is about to move from its now extensive plant to larger quarters.

Something New Under the Sun.

Such an invention as the one referred to below offers golden opportunities for capitalists to invest some of their spare millions. The device is what the world has been looking for for years, and that the solution of this interesting and difficult problem should have been accomplished by a comparatively obscure person, is further evidence of the fact that wisdom does not always lodge in high places. We shall not attempt to describe the inventor's device; his own description leaves nothing for us to do but to reproduce it entire by the photo-engraving process.

SOMETHING NEW.

Robert Gidley of

Verbank Village, Dutchess Co., N. Y.

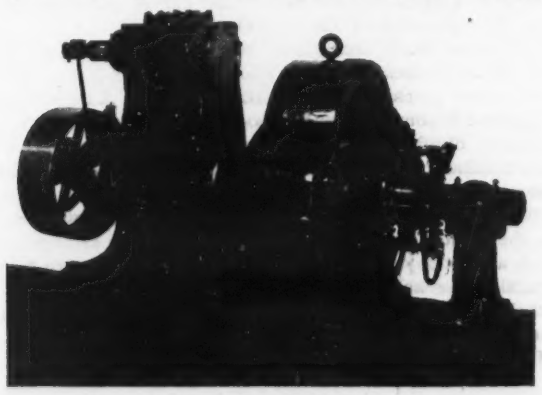
Is the inventor of a new telegraph device for the conveying of Railroad Cars on all railroads that are provided with steam, at the present time, with telegraph lines or without. My device opperates all railway lines that are opperating railway cars with steam and all telegraph lines, that are opperating telegraph lines, with the same device doing the whole thing, conveying the cars from point to point, giving the telegraph operation at the same time, with my device. My devices operates the cars at any height of grade, from one foot to one thousand feet per mile, showing a higher grade than any other device ever invented. My device holds a train or car at any desired point by means of an automatic brake. Any person wishing to see their construction and operation can see them at the above named places as herein set forth. my device dus away with all Telegraph poles but is supported by the track.

Compact Generating Plant.

The Onondaga Dynamo Company, Syracuse, N. Y., has always produced electrical apparatus of the highest efficiency and economy, and any improvements possible have been made from time to time. The company is now putting out motors and generators of the highest order.

The American Fire Engine Company, Seneca Falls, N. Y., widely known as the manufacturer of the Silsby fire engine, has recently placed in its factory a 15-kw Onondaga dynamo, direct-connected to a 25-hp Case automatic engine, a general view of which is given herewith.

The dynamo is of the multipolar type, and combines all of the latest improvements in dynamo building. It is guaranteed not to spark at the brushes upon throwing on and off the full load, and this without any



Direct-Connected Generating Set.

shifting of the brushes. Carbon brushes are used, and the brush-holders are so constructed that the brushes may be easily removed while the dynamo is in operation. The brush-holder is novel, and so designed that a uniform bearing surface is obtained with a minimum pressure, thereby

causing the smallest amount of friction upon the commutator, and in nowise causing any heat on account of brush friction.

The dynamo is so designed that the heating limit shall not exceed 60 degrees F. above the temperature of the surrounding atmosphere.

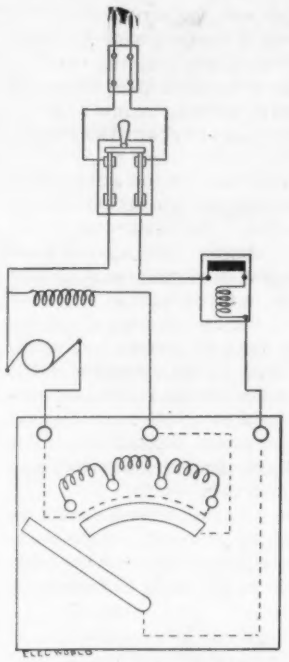
This outfit is recommended where space is limited, as the dynamo and engine occupy a space of only 5½ feet x 2 feet 10 inches.

The Onondaga Dynamo Company is ready to submit specifications for direct-connected units of capacities of 15, 25, 25, 45, 60, 75, and 100 kilowatts.

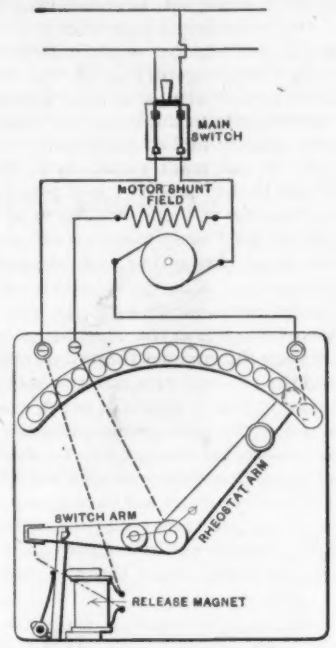
Requirements of the New York Fire Department Regarding Magnetic Motor Protecting Devices.

The present rules of the New York Fire Department Electrical Inspection Bureau governing the installation of electric motors are in some respects a decided departure from past inspection regulations. The grounding of motor frames wherever an inadvertent ground is possible and in all cases where the voltage exceeds 300 volts is required in all motor installations. The speed and capacity of the motor must also be permanently stamped directly on the "ironwork" of the motor and not on a detachable name plate as heretofore. The most interesting section of these requirements, however, is that relating to the installation of "both fusible and magnetic circuit-breakers, of which one at least must be double pole," in connection with motor-starting boxes "when connected to motors exceeding one horse-power." The rule further states that the magnetic cut-out or switch must automatically cut off current from the motor whenever the supplying circuit is interrupted and also when the normal current of the motor is exceeded. In view of the present development of electromagnetic protective devices, this requirement is of particular interest.

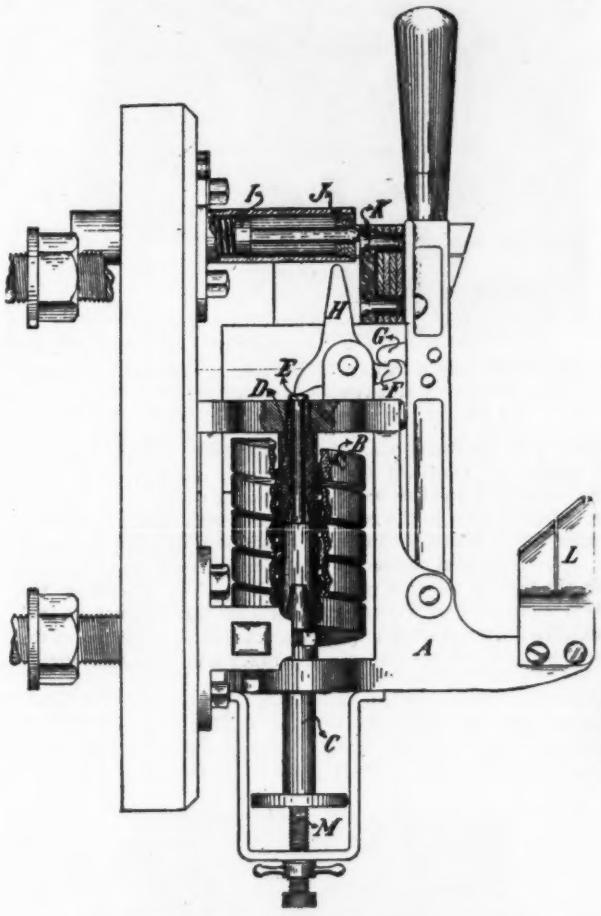
This rule may be complied with in one of several ways. An automatic over-load circuit-breaker, which may be single pole inasmuch as a double pole fusible cut-out is usually installed, may be used in connection with any approved hand starting box, preferably with a magnetic open-circuit release. Starting boxes with high and low load release, or combinations of circuit-breaker and starting box devices, are also approved if meeting the requirements.



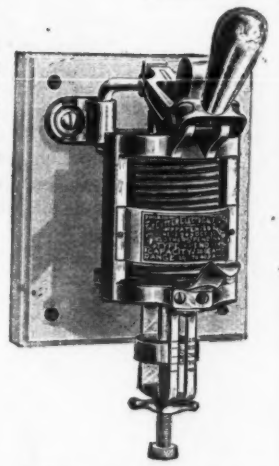
ORDINARY CIRCUIT-BREAKER.



CONNECTIONS OF LEONARD UNIVERSAL RHEOSTAT.



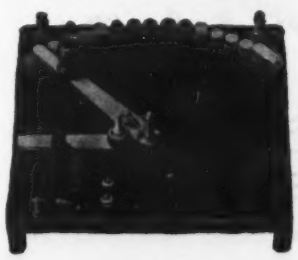
DETAIL SECTION OF I-T-E CIRCUIT-BREAKER.



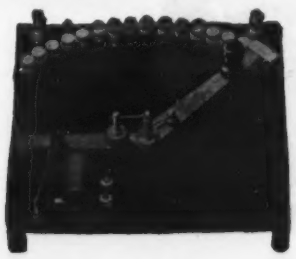
I-T-E CIRCUIT-BREAKER.

Among the devices passing inspection the "I-T-E" circuit-breakers, made by the Cutter Electrical & Manufacturing Company, Philadelphia, Pa., have been quite extensively adopted. This device is so well-known that a description is unnecessary. A special over and underload motor circuit-breaker has been designed, which consists of a single solenoid fitted with two concentric iron cores, one to be actuated by an excess current and the other by minimum current. The overload point can be set within certain limits. When the current exceeds this point or the circuit is broken, one of the cores acts on the trip, releasing the switch. Any of the standard "I-T-E" over-load circuit-breakers will also pass muster, even if used with an ordinary hand starting box, as the circuit-breaker switch will not remain closed unless the starting box is properly set to prevent any rush of current.

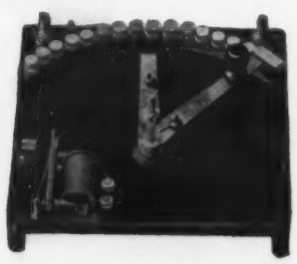
A special motor over-load circuit-breaker is manufactured by the Electric Circuit Breaker-Company, Newaygo, Mich. An electromagnet is used to actuate the switch, which is released when the armature of the magnet is attracted, and thereby moving a small catch out of engagement with the spring-actuated switch bar. The point at which the armature is attracted can be adjusted by moving the magnet cores to or from the armature by a set screw. Supplementary carbon breaks are provided in addition to the regular switch blade contacts, so that destructive sparking at the switch blade is prevented. This device has a wide range of adjustment, and is said to be very efficient for the work done.



Starting.

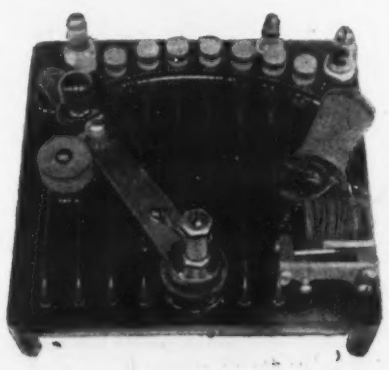


Full Speed.



Automatically Stopped.

LEONARD UNIVERSAL AUTOMATIC RHEOSTAT.



LEONARD AUTOMATIC OVER-LOAD DEVICE.

The Ward Leonard Electric Company, Hoboken, N. J., manufactures a combined over and under-load circuit-breaker and starting-box which embodies a number of very ingenious features. The protective device is attached to a Carpenter enamel rheostat of suitable size, and consists of but a single coil club foot magnet, in series with the entire motor.

The armature of this magnet controls a switch contact blade, pivoted at one end together with the rheostat contact arm, and a spring tends to bring them together as shown, when either is released after being set. This switch arm acts as a single pole main switch, connecting the rheostat arm to the main line magnet. The diagram shows the general arrangement and connections.

When the main switch is closed, the upper end of the armature is drawn to the rounded upper pole piece of the magnet, which then acts as the fulcrum of the lever formed by the armature. The lower end of the latter is held away from the adjustable lower magnet pole by the fixed flat supporting spring, and the pull of the magnet on either pole is against this spring. The upper end of the armature is fitted with a hard steel spring latch which engages with a pin on the switch arm when the rheostat arm is at the starting position. As long as current is passing through the magnet the switch arm will be held by the armature latch and the rheostat arm can gradually be moved over the resistance contacts to the "all out" point, where it is held by a clip, against the action of the spring connecting the two contact arms. Should the circuit be broken, the magnet will be de-energized, releasing the armature and allowing the spring-actuated switch arm to open the circuit.

After the circuit has been opened it cannot be again closed except by bringing the resistance arm back to the starting point. If, on the other hand, the current has exceeded the limits for which the magnet has been set, the lower end of the armature lever will be attracted and the latch at the other end will again be drawn out of engagement with the pin on the contact arm, producing the same result. The resistance contact arm cannot be left at any intermediate point, and if moved too rapidly will cause an excessive flow of current and release the switch-arm. It is to be noted that the shunt-field circuit of the motor always forms a closed circuit with the armature, so that when the switch opens there is no field discharge and destructive sparking.

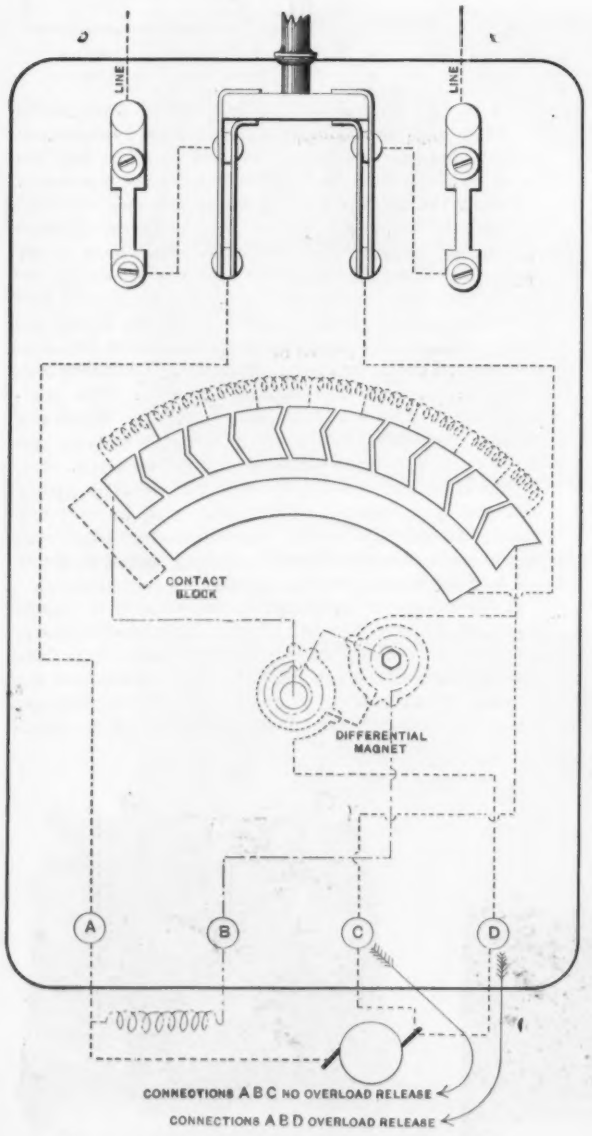
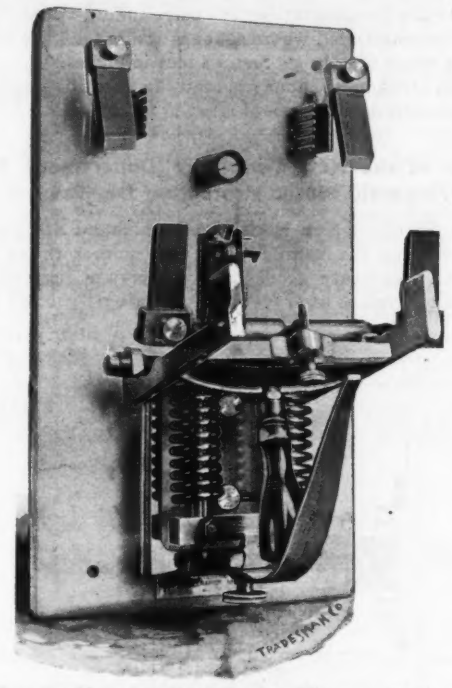


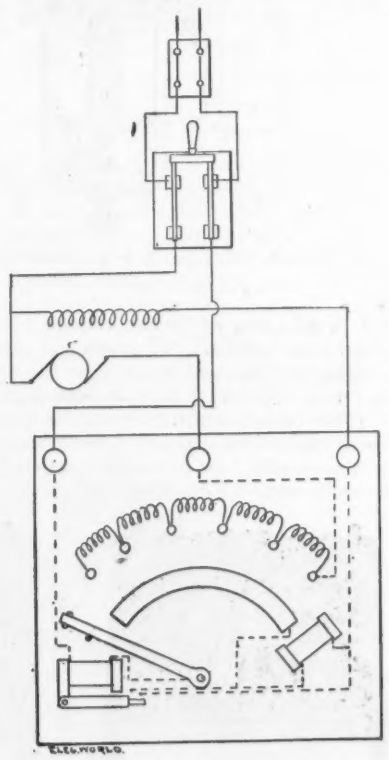
Diagram of C & C Motor Controlling Box.

C & C Motor Controlling Box.

In addition to this starter the Ward Leonard Electric Company has recently added to its ordinary Carpenter automatic release starting rheostats an automatic overload device which in no way affects the working of the apparatus, and can be attached to any rheostat of this type already in use. In addition to the release magnet with which such rheostats are equipped, and which is connected in shunt across the armature of the motor, a small magnet connected in series with the main circuit is mounted on the face of the iron resistance plate. The circuit of the shunt magnet is controlled by the armature of this last magnet, so that when the armature is attracted by an overload current, the circuit of the shunt magnet is broken and the resistance contact arm released. Either type of starting rheostats may be used in connection with any type of motor and are independent of the field windings.



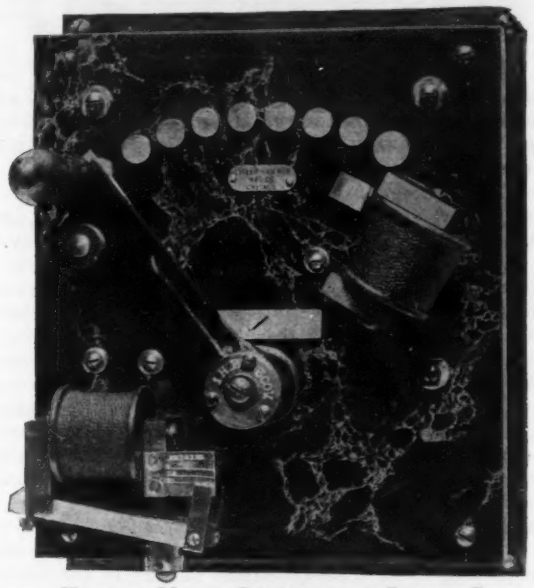
Electric Circuit-Breaker Company's Motor Overload Circuit-Breaker.



Connections Cutler-Hammer High and Low Load Starting Rheostat.

A very unique high and low load starting resistance box has lately been brought out by the C & C Electric Company, New York City, which was particularly designed to meet these requirements. This device

might more properly be named a motor controlling box, as it includes not only the necessary starting resistance and high and low releasing devices, but a double pole main switch and fusible cut-out, also mounted

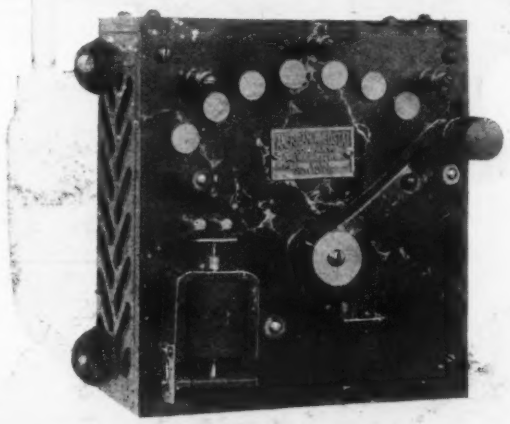


CUTLER-HAMMER MOTOR STARTER AND CIRCUIT-BREAKER.

on the marbleized slate plate forming the front of the box. The resistance consists of coiled wire open to the air.

The pivoted contact bar is made up of two parts, one forming the contact arm proper, and the other, with which it is loosely connected, serving as the iron armature of an electromagnet placed on the other side of the slate. The contact arm is pivoted on one pole of this magnet, while the other is placed at a slight radial distance therefrom, and acts as a stop for the iron armature, which strikes against it when the resistance is all cut out.

The magnet is wound differentially, one of the windings being in series with the armature, while the other is in series with the shunt field. Closing the main switch and moving the arm to the right, connects the field of the motor and cuts out the armature resistance. This increases the motor speed, and the maximum is reached when the iron arm strikes the stop and is held there by the magnet. The windings of the magnet are arranged so that under normal conditions the winding in series with the shunt field overbalances the other until the predetermined overload limit is reached, at which point the increased current in the latter neutralizes the magnetic effect, and releases the contact arm. An open circuit produces the same result. This starting box may be



AMERICAN RHEOSTAT COMPANY'S MOTOR STARTER WITH AUTOMATIC RELEASE AND OVERLOAD.

operated with or without the overload feature as indicated, and is designed particularly for C & C motors.

The high and low-load rheostat, made by the Cutler-Hammer Company, Chicago, Ill., operates practically on the same general lines as any ordinary automatic open circuit release device. The overload feature is produced by means of a separate electromagnet in the main circuit, which, when sufficiently energized, attracts its armature, and thereby short-circuits the releasing magnet. The overload magnet can be adjusted by a set screw on the armature. The resistance consists of coiled wire on proper supports. Both the armature and field circuits are broken when the contact arm is released.

Another automatic high and low load rheostat motor is manufactured by the American Rheostat Company, Milwaukee, Wis., and apparently complies with the requirements.

This starter is equipped with two contact arms, one controlling the resistance in series with the armature and the other acting as a switch arm. When the resistance contact arm is in the "all out" position the switch-arm is held against the action of a spring by an electromagnet in series with the field winding. Any interruption of the circuit de-energizes this magnet and releases the switch arm, which cannot be replaced until the rheostat arm is brought back to its original position. By means of a separate overload device attached to the box the releasing magnet is also de-energized when the current has exceeded the overload point. The circuit-breaking is entirely confined to the lower switch-arm and contacts, which therefore saves the resistance contact from all sparking.

The Shelby Incandescent Lamp.

While there seems to be a tendency at the present time to lower the price of incandescent lamps there are some lamp manufacturers who maintain that general superiority and efficiency are preferable to low cost. The lamp manufactured by the Shelby Electric Company, Shelby, O., is the invention of Prof. A. A. Chaillet, the technical manager of the company. Prof. Chaillet's experience in the manufacture of incandescent lamps extends back to the earliest productions in Europe.

The lamp possesses a number of peculiar features which it is claimed give to it certain elements of superiority above all others. The filament is square cut by means of automatic machinery from sheets of material produced by a secret chemical process. The cut filament, after being formed, is attached to platinum terminals which are sealed into the sides at the lower end of the lamp bulb. The filament is of such high resistance that in the Shelby lamps it is shorter than that of most other commercial lamps of equal rating. The bulb is not exhausted from the top, which in connection with the exceedingly small filament used makes the completed lamp one of the smallest, also one of the neatest, lamps on the market. The lower terminal end of the bulb is left open for exhaustion,

NEW LAMP.—FULL SIZE.

which is accomplished by a special process involving both mechanical and chemical operations.

The illustration herewith shows a 175-volt 16-cp lamp, full size, and in comparison with other standard lamps will readily corroborate the above statements regarding small size.

The high-voltage (220-volt) lamps made by this company are especially notable for their small size and the fact that but a single filament is used. In fact, these lamps are but very little larger than those of lower voltage.

The efficiency and life of this new lamp are matters particularly dwelt upon by the company.

The accompanying table gives results obtained by the company in some tests of Shelby lamps of various candle-powers. These figures seem to substantiate the claims made for long life and high efficiency:

TESTS OF SHELBY LAMPS, VARIOUS CANDLE-POWERS.

220-volt lamps.....	800	hours	4	watts	per candle-power.
	1000	"	4½	"	" "
	1500	"	5	"	" "
110-volt lamps.....	600	"	2.5	"	
	800	"	2.8	"	
	1000	"	3	"	
	1200	"	3¼	"	
	1500	"	3½	"	
50-volt lamps.....	500	"	2	"	"
	600	"	2¼	"	"
	800	"	2½	"	"
	900	"	2¾	"	" "
	1000	"	3	"	" "
	1500	"	3½	"	" "

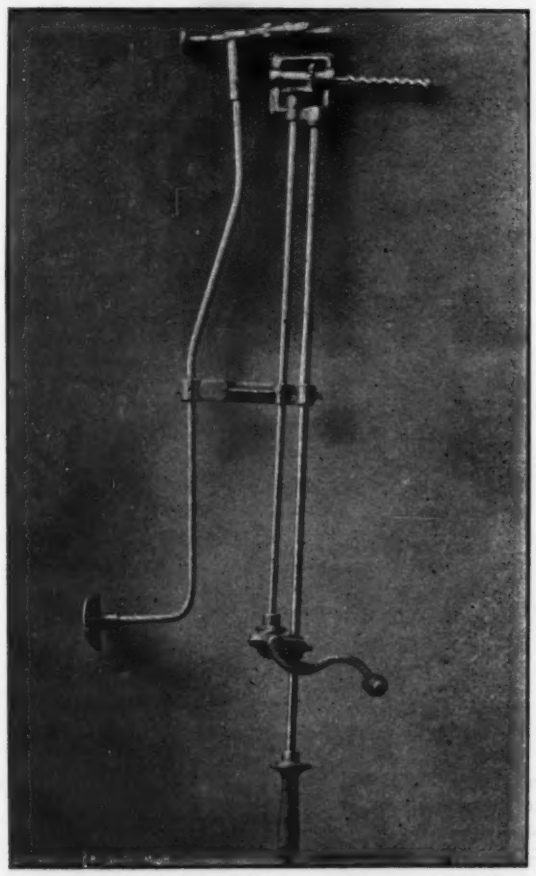
Regulation within 2 per cent.

The company prides itself upon its business and technical staff. The president is W. W. Skiles; vice-president, G. M. Skiles; treasurer, M. H. Davis; secretary, John C. Fish, and the technical manager Prof. Chaillet. Joseph Hardwick, formerly connected with the lamp department of the Thomson-Houston Electric Company, and Charles F. Stillwell, who was associated with Mr. Edison during the evolution of the Edison lamp, are Prof. Chaillet's assistants.

A New Joist-Boring Machine.

One of the greatest difficulties which exist at the present time in the wiring of buildings, and one which causes the wireman trouble untold, in addition to considerable loss of time, is the boring of overhead timbers and joists for the passage of wires. This trouble and loss of time are frequently so great as to increase the cost of installation by an appreciable percentage, which is a direct and total loss of money to the contractor.

Our attention has been called to an overhead joist-boring machine, handled by the Metropolitan Electric Company, Chicago, that seems to meet this need. This machine, it is claimed, will do about three times the amount of work of one man when he uses the ordinary angle brace. At this rate a machine should easily pay for itself within two or three



Joist Boring Machine.

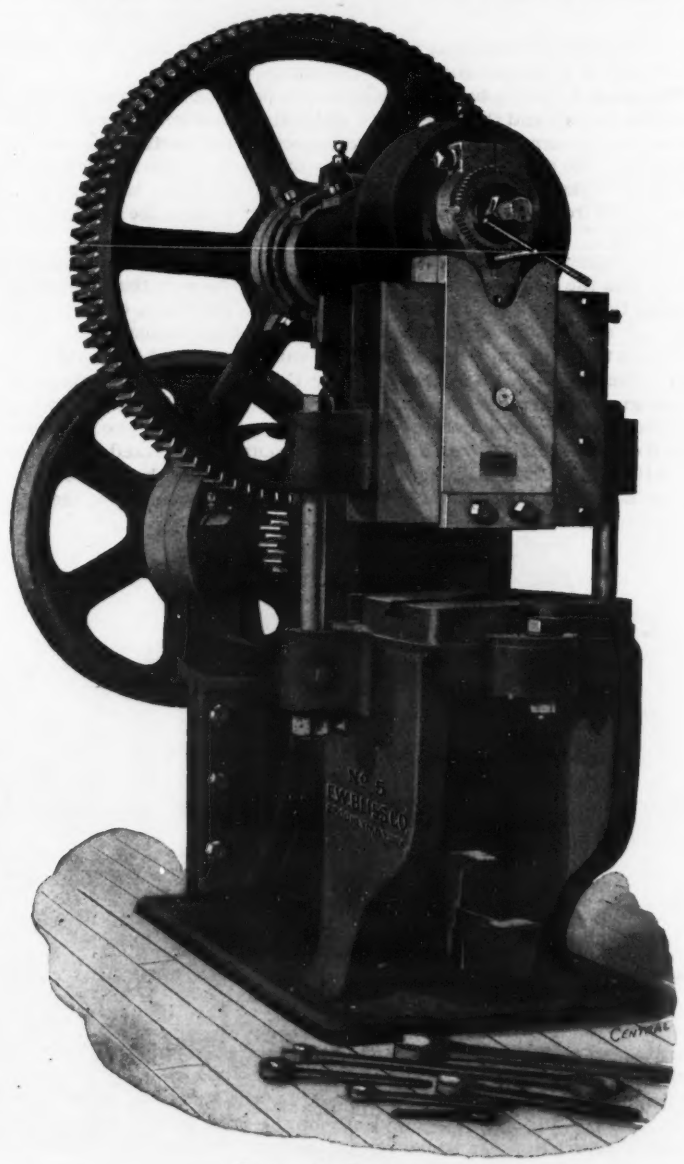
weeks' time. This tool bores a hole of any size and straight through the joist, thus greatly facilitating the stringing of wires. The machine is so constructed that it can be quickly adjusted to any width of space between joists and allows the operator to reach up over his head when using the machine. The bit, which is rigidly held in the chuck, can be easily removed when desired and a different bit inserted.

The whole machine is substantially built for work, and as there is nothing about it to get out of order, it thoroughly commends itself to a workman. No concern doing wiring should be without one or more of these instruments.

Geared Punching Press.

The accompanying illustration shows a modification recently made by the E. W. Bliss Company, 12 Adams Street, Brooklyn, N. Y., in its standard No. 5 "Stiles" geared press, in order to give more rigidity to this press when it is used for heavy work. By means of stay-rods the press is made to combine the advantages of the overhanging frame with those of the straightsided pattern. These stay-rods can be removed when using the press to cut out of the full sheet, when they would be in the way. They are, however, especially desirable when the press is used for embossing, heavy stamping and shaping. This machine is otherwise provided with the well known features of the "Stiles" presses, namely, "Stiles" graduated eccentric adjustment and the "Stiles" clutch, and is built in an exceedingly solid and accurate manner. Its principal dimensions are as follows: Size of opening in bed, 11 x 14 inches; distance back from centre of slide, 10½ inches; distance from bed to bottom of slide when stroke and adjustment are up, 9 inches; standard stroke, 1½ inches; weight of fly-wheel, 900 pounds; speed of fly-wheel per minute, 175 revolutions; proportion of gearing, 1 to 7; floor space over all, 52 x 86 inches, and weight complete, about 9000 pounds.

The range of work for which this press is adapted covers nearly every kind of blank cutting, punching, perforating, forming and bending, including a large proportion of the operations needed in the manufacture



Punching Press.

of many articles made out of sheet metal. In electrical work it is especially adaptable in all cases where a machine is required for heavy punching, etc.

The "Stiles" patented graduated eccentric adjustment is an especially valuable feature of this machine, the graduation being marked to 1-100 inch on the eccentric disc enabling the operator to keep an exact record of the dies and set them without loss of time.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 3, 1897.

ELECTRICAL STOCKS.—There is an upward tendency manifest in this list of stocks, some of the advances being Edison Electric Illuminating of New York, Electric Storage Battery, common and preferred; General Electric, common, and Westinghouse, common.

TELEGRAPHS AND TELEPHONES.--American Bell Telephone shows the only advance in this list, being three points higher than it was at the time of our last quotation. The course of the market, with this one exception, was downward, Commercial Cable losing two points, and Western Union one.

ELECTRIC TRACTIONS.—Nothing special has transpired in the street railway security market since our last report, there seeming to be general inactivity. What business was transacted was evidently influenced more by local conditions than anything general. Brooklyn Rapid Transit gained three quarters and West End common and preferred one half point each.

THE ERIE TELEGRAPH & TELEPHONE COMPANY.—A quarterly dividend of 1 per cent. will be paid on Feb. 15. The annual statement of sub-companies shows gross income of $1,206,147.40, gross expenses, $706,134.73, net earnings, $500,012.67; dividends, $461,662.50, leaving a surplus of $38,550 17; proportion of dividends received by the Erie Telegraph & Telephone Company $314,913.75; proportionate part of the surplus of the sub-companies due to the Erie Telegraph & Telephone Company, $26.368.96. The company has a total of 21,389 subscribers.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked.
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	104¾	106
" " " Brooklyn	100	88	93
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	30	30¼
Electric Storage, pref	100	32	32½
General Electric	100	35¾	35⅞
General Electric, pref	100	77	78
Westinghouse Consolidated, com	50	25	26
" " pref	50	50	51½

BONDS.

Edison Electric Ill., New York	105	106½	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	95⅛	—

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	215	217
American District Telegraph	100	*29	39
American Telegraph & Cable	100	..	90
Central & South American Telegraph	100	124	127
Commercial Cables	100	156	172
Erie Telephone	100	65⅞	..
New England Telephone	100	102	..
Postal Telegraph-Cable	100	91	94
Western Union Telegraph	100	83	83⅜

ELECTRIC TRACTION STOCKS.

Baltimore Traction	25	17½	17⅝
Brooklyn Rapid Transit		18¾	19½
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	73	75
Cleveland Electric Ry	100	.	..
Columbus St. Ry	100	40	42
Hestonville	100	52	52½
" pref		..	62½
New Orleans Traction	100	..	11
" " pref	100	..	45
North Shore Traction	100	22	24
" " pref	100	77	80
Rochester St. Ry	..	..	20
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	103
Union Traction, rcts $10 pd		12½	13
West End, Boston	100	64½	65
" " pref	100	89½	90
Worcester Traction	100	20	22
" " pref	100	95	98

BONDS.

Brooklyn Rapid Transit 5s. 1945	100	79	..
Buffalo St. Ry. 1st con. 5s	100	*107	110
Cleveland Elec. Ry. 1st mtge 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge 5s		*101	104
*Westchester Electric 1st mtge 5s	100	100	103

* With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Feb. 3, 1897.

FIRE.—On the night of Jan. 30 fire in the building No. 254 Greenwich Street, in which is located the storeroom of H. D. Bayne & Co., dealers in electrical supplies, damaged the stock of this firm.

NEW BUILDING FOR THE WESTERN ELECTRIC COMPANY.—The Western Electric Company will construct a 10-story brick office and factory building at the corner of West and Bethune Streets. It will have a frontage of 145 feet and a depth of 285 feet.

METROPOLITAN TRACTION COMPANY INDICTED.—On Jan. 29, the Grand Jury indicted the Metropolitan Traction Company and the Metropolitan Street Railway Company for maintaining a public nuisance in propelling cars at speed on the curve at Broadway and Fourteenth Street.

THE STANDARD ELECTRIC LAMP & NOVELTY COMPANY.—Mr. Charles A. Fowler, who organized this company and established the business at 248 West Twenty-third Street, New York City, has resigned as president of the concern in order to give his time to other interests. Mr. C. B. Sterling succeeds Mr. Fowler as president. Mr. Sterling has had wide experience in this line, and is well qualified to conduct the affairs of this prosperous concern.

STREET RAILWAY FRANCHISES IN GREATER NEW YORK.—At the meeting of the Greater New York Commission on Jan. 28, some important matters relating to the granting of franchises for the use of city streets were disposed of in connection with the consideration of the new charter for the Greater New York. It was decided that no more grants in perpetuity of street railway companies should be made by the city. Twenty-five years was fixed as a limit of time that all of them shall run. Franchises for street railways will be sold at auction as now, but the purchaser must bid with the understanding that at the end of 25 years the city may take the property and operate it. In the event that the city does not elect to take the property the purchaser may re-lease the privilege for another 25 years, when the city will again have the alternative right of taking the road or re-leasing it. It is not the intention to confiscate the property. The city will pay a fair valuation for the same, said valuation to be determined by a method set forth in the original terms of sale. In the case of re-lease the railway will not secure the privilege of the continued operation of the road on the original terms; increased payment for the privilege will be insisted on.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Feb. 3, 1897.

MR. FREDERICK BISSELL, president of the large and thriving electrical house, the Bissell, Dodge & Erner Company, Toledo and Columbus, O., was in Boston for a few days this week.

THE LYNN INCANDESCENT LAMP COMPANY, Lynn, Mass., is about as busy as it can well be. The business record this company has thus far made is really remarkable, and orders continue to increase, to take care of which additions to its working force are constantly being made. Very soon the company will be located in a new plant with ample facilities, which emphatically argues that the "The Lynn Renewed Lamp" is a success, and is appreciated by the trade.

THE WEST END STREET RAILWAY COMPANY, Boston, was taxed to its utmost during the recent severe snowstorm—the most formidable in years—but did not, nevertheless, fail to perform its customary creditable and prompt service, although there were natually some delays by blockage. In several instances, owing to drifts and freezing of snow to the tracks, the electric plows failed of duty. For the first time since the electrical equipment of the road the horse plow was brought into service.

THE AMERICAN CIRCULAR LOOM COMPANY, Boston, Mass., has issued a well illustrated catalogue of its well-known flexible conduit for electric wiring. The advantages of the American Circular Loom Conduit may be enumerated as follows: It is thoroughly flexible; waterproof; requires no joints or elbows; will not readily ignite; wires will not stick in it, and it can be furnished in any length. This tubing has passed the rigid inspection of the Underwriters' International Electrical Association, and will be found specified in their rules and requirements as the American Circular Loom Tube. The catalogue contains several excellent illustrations of prominent buildings throughout the country in which flexible conduit is used and a list of hotels and apartment buildings and theatres, schools, churches and hospitals, residences, etc., in which this tubing was adopted in the installation of the electric light.

Western Notes.

Branch Office of THE ELECTRICAL WORLD,
936 Monadnock Building,
CHICAGO, ILL., Feb. 1, 1897.

MR. E. WARD WILKINS, of the Partrick & Carter Company, Philadelphia, Pa., honored the Western office of THE ELECTRICAL WORLD with a call on Jan. 28. Mr. Wilkins is on an extensive business trip and will stop at many of the principal cities between Chicago and San Francisco.

THE CENTRAL ELECTRIC COMPANY, Chicago, is carrying in its stock a complete line of snap, flush and push switches of the following makes: Hart, Perkins, Xntric, Stevens and C. S., and is prepared to furnish these goods made up in gangs with any particular finish, to match special hardware. This company is publishing a four-page folder price list of the Stevens push button switches, which it states will be gladly mailed to any one in the business upon receipt of a communication requesting a copy of the same.

THE CHICAGO ELECTRICAL ASSOCIATION.—The programme of the Chicago Electrical Association for this season includes papers as follows: Feb. 19, Vacuum Tube Lighting, by M. A. Edson; March 5, Electrical Resonance, by Kempster B. Miller; March 19, Cable Testing, by George D. Hale; April 2, Requirements of High-Speed and Heavy Electric Traction, by Hayward Cochran and E. J. Swarteur; April 16, Arc Lighting in America and Europe, by C. Wiler; May 7, Direct-Current Transformers, by C. H. Thordarson. On May 21 a banquet will be held by the association. The meetings are held on the first and third Fridays of each month, from October to May inclusive, at Room 1737, Monadnock Block.

THE CONOVER-GOE COMPANY.—This concern, although a new company in one sense, is by no means new to central station managers and electrical people throughout the United States. The business to be carried on is in reality an amalgamation of the interests in the Western States of several different concerns, under the management of Messrs. Conover and Goe. The firm is composed of Messrs. George W. Conover and D. E. Goe, and it is the purpose of these gentlemen to extend their field of operations, and to increase the demand for the output of the various factories represented by them as a company. The company has contracted for the entire output of the electrical and hardware specialties manufactured by the C. H. Dickey Tool Company. Other concerns represented in the Western States by this company are the Paragon Arc Lamp Company, Boston; the Gibbs Electric & Manufacturing Company, Hartford, Conn., manufacturer of Hartford switches, and C. S. Knowles, Boston, Mass., manufacturer of and dealer in porcelain specialties, rubber goods and insulated wire. Other important deals are about to be consummated, and there is every reason to believe that the Conover-Goe Company will meet with a prompt and gratifying success.

THE STANDARD UNDERGROUND CABLE COMPANY.—The annual meeting of the stockholders of the Standard Underground Cable Company was held at the company's offices in Pittsburg, Pa., on Jan. 26. The old Board of Directors was re-elected for the ensuing year. The report of the Board of Directors showed a total business of nearly three quarters of a million dollars for the year 1896; four dividends of 2 per cent. each were paid out of the earnings for the year, and the remainder was added to the surplus account. The assets of the company aggregate $1,412,046.06, and the liabilities, exclusive of capital stock, are $106,928.08, while the surplus over and above all liabilities (including capital stock of $1,000,000) is $308,107.19. The company's factories are reported in first-class condition for economic and rapid manufacture of wires and cables of all kinds, all departments running, and the rubber department being especially crowded with orders at this time. The prospects for 1897 are considered very flattering, a number of large contracts, aggregating nearly $250,000 being now on the company's books, most of which have been secured since Jan. 1, and covering all classes of this company's products. A specially gratifying feature pointed out by the Board of Directors is that the number of customers on the company's books for the year 1896 is 50 per cent. greater than for any previous year. The company's branch offices are managed by experienced men in this line of business, *viz.*: New York office, Geo. L. Wiley, manager Eastern sales department, assisted by T. E. Hughes, as manager of the bare and insulated wire department. Philadelphia office, 336 North Broad Street, E. W. Dugdale, superintendent of construction; Chicago office, The Rookery, J. R. Wiley, manager Western sales department, including St. Louis, Mo., with F. C. Cosby as assistant manager.

St. Louis Notes.

ST. LOUIS, Feb. 1, 1897.

NO RECEIVER.—The application made in the United States District Court Jan. 30, for a receiver for the St. Louis & Kirkwood Electric Railway was denied by Judge Adams. The petition was presented on the ground that the company had defaulted on the interest on its bonds. There is quite a fight going on among the officials, and it is barely possible that I. H. Houseman, president of the company, may be brought before the court on the charge of contempt.

BANQUET OF THE ST. LOUIS ELECTRICAL EXCHANGE.—The fifth annual banquet of the St. Louis Electrical Exchange took place Saturday night, Jan. 30, at the Merchants' restaurant, with an attendance of about 35 members and several invited guests. The hall and tables were handsomely decorated with smilax, in the midst of which there were a large number of different colored incandescent lights. The Neapolitan Mandolin Club furnished music during the banquet. A. Boeschinstein, the president of the exchange, presided, and on his right and left were seated the other officers, R. W. Dodsworth, vice-president; Arnold Doxsee, treasurer; Otto Kuhn, secretary, and Geo. Andreas, sergeant-at-arms. The toast-master was E. T. Cooke, of the Cooke Electrical Company, and as each person was called on he made a few remarks. Among those who spoke were: Mr. Fenton, chief inspector of the Underwriters' Association; Henry Cunningham, of the Edison Electric Lighting Company; Mr. Routell, of the Routell Electric Company; Otto Kuhn, of the Adams Electrical Company, and secretary of the Exchange; Mr. I. J. Kusel, of the Missouri Telephone Company; J. H. Cooke, of the Cooke Electrical Company, who returned about Christmas from Europe after several months' absence, and who related some of his experiences there, and Mr. Stanhope, of the St. Louis Electric Company. Ex-Mayor Noonan, one of the invited guests, also entertained the members with some interesting remarks. Several other features, such as songs, dances and stories, and which were not down on the programme, were given. The menu was quite an elaborate one, and thoroughly enjoyed, and it was long after midnight before the entertainment came to an end, after being voted one of the most enjoyable ever given. The Commercial Electric Company was not represented, but it sent a note of regret, and requested that a case of champagne be drunk at its expense, which, it is hardly necessary to say, was done.

Canadian Notes.

TORONTO, CAN., Jan. 29, 1897.

MOTOR CARRIAGE.—Much interest in Toronto centres around the patent of Mr. W. J. Still, of an electrical motor carriage. The design is after that of the London hansom cabs with the driver occupying a seat inside in place of in the usual style, high up at the back. Several experiments in running have been made on the streets of Toronto, exciting a great deal of curiosity. Mr. Still is confident that he has overcome the usual objection to storage batteries in point of great weight, and anticipates having his patent practically on the market in a short time,

ACCIDENTAL DEATH OF MR. E. CARL BREITHAUPT.—On the evening of Jan. 22 an explosion occurred at the gas works in Berlin, Ont., which resulted in the violent death of Mr. E. Carl Breithaupt, second vice-president of the Canadian Electrical Association, and one of the best known electrical engineers in the Province, and Mr. William Aldrich, mechanical superintendent of the works. The disaster was caused by the explosion of a coal oil tank from which oil was being taken, in the light of a lantern. The gas ignited, with the result that the tank exploded, instantly killing Mr. Aldrich and throwing Mr. Breithaupt into the air 30 feet. Mr. Breithaupt landed on the roof of a building, terribly injured, and died at 2 o'clock on the following morning. The physicians in attendance stated that death was due to shock and the effects of internal injuries. Mr. Breithaupt has been one of the most active members of the Canadian Electrical Association since its organization. He was chairman of the Committee on Statistics and did some excellent work in securing data of the condition of Canadian electrical affairs. Besides being manager of the Berlin Gas Works he was also president and general manager of the Berlin & Waterloo Street Railway Company, and was identified with other electrical railway projects in the district in which he resided. Mr. Aldrich was an electrician of recognized ability and an authority in mechanics.

English Notes.

(From Our Own Correspondent.)

LONDON, Jan. 20, 1897.

FIRES AT CENTRAL STATIONS.—An outbreak of fire took place at the central station of the Crystal Palace District Electric Supply Company last week. From accounts to hand it would appear that a mass of insulated leads became overheated and took fire with the result that a large amount of damage was caused to the engine room.

CANALS AND ELECTRIC LIGHTING.—A somewhat novel departure is contemplated by the Leeds & Liverpool Canal Company. For some time past the Gas Committee of the Bingley Town Council has been considering a proposal for the electric lighting of that town by the canal company. It is the intention of the company to establish works at Bingley for the generation of electricity by means of the fall of water at the five rise and three rise locks at Bingley. The directors of the canal company have offered to supply the District Council with electricity at the price of 4d. per unit, and the novel proposal is now being considered.

THE BRUSH COMPANY.—The following changes have been announced in the management of the Brush Electrical Engineering Company, and in view of the by no means healthy condition of this concern these changes are in the nature of portents. Mr. J. S. Raworth, who is very well known in this country, and whose name has recently come before the engineering world in general in connection with his "Universal" steam engine, has resigned his position as manager and chief engineer and now becomes consulting engineer and a director of the company. Mr. W. M. Mordey, who has for so many years been the chief electrician to the Brush Company, will in future act as consulting electrician and will be free to undertake other work. The general manager of the company will in future be Mr. Percy Sellon.

SIR HENRY MANCE'S PRESIDENTIAL ADDRESS TO THE INSTITUTION OF ELECTRICAL ENGINEERS.—For the first time in 10 years the Institution of Electrical Engineers was on Thursday evening last week treated to a presidential address, dealing mainly with submarine telegraphy. The last one of this kind was delivered on Jan 13, 1887, by Sir Charles Bright. It was generally admitted that Sir Henry Mance succeeded in making his subject interesting, and one or two of the members went so far as to say that it was the best presidential address yet delivered. The address has attracted considerable attention in the daily press by reason of Sir Henry's arguments made with the view of laying the spectre of telegraphic isolation on the outbreak of war, conjured up by imaginative writers in the daily papers. Sir Henry's lifelong connection with submarine telegraphy enables him to speak with authority, and he points out that to cut a cable in deep water in time of war, the exact location of which is not known, is a task requiring considerable daring, skill and knowledge, and of the latter two quantities, so far as submarine telegraphy is concerned, England possesses a monopoly. On the other hand the cutting of cables in shallow waters near our shores or those of our colonies will be attended with great risk to the cable cutters if our navy does its duty, as it has a "nasty" habit of doing, and moreover, if cables

are cut in shallow waters they are easily repaired. While, therefore ardently advocating the Pacific Cable on strategic and commercial grounds, Sir Henry Mance is not inclined to attach overmuch importance to the possibility of England being telegraphically isolated the moment it finds itself involved in hostilities. Sir Henry Mance's experience also is that submarine cables require a remarkably small amount of repairing. In other words, their depreciation is extremely slow. Thus after 21 years' sojourn at the bottom of the sea a shallow water cable may, he says, be expected to require a new core only to the extent of 3 per cent. of its total length, but as he pointed out, a cable only requiring this microscopic amount of repairing, would in many cases be a nuisance. That is to say, assuming it were a 1000-mile line, 3 per cent. would mean 30 miles of new cable, and 30 miles of new cable would mean about 12 repairs, or an average of one interruption per month, a number far too great if the cable happened to be a portion of an important circuit. Sir Henry Mance evidently anticipates that the slow permeation of Mr. Oliver Heaviside's views into the minds of submarine cable men and others, will not now be long without bearing fruit in the shape of a fundamental alteration in our cable design, and in the accomplishment of oceanic telephony. He also refers with some pride to the fact that although the art of localizing faults in submarine cables is scarcely more than half a century old, it has attained such perfection that to-day faults may be localized within one-third of a mile of their actual locus; that is to say, faults may be localized with a far greater degree of accuracy than ships can be navigated.

PETRIFITE.—Yesterday afternoon an exhibition took place before a number of representatives of the technical and general press, of the products of a new cement known as "Petrifite," the works at which this material is employed being at Blackwell, down the Thames. The exact composition of this material was not divulged, but it is a whitish powder possessing very strongly all the properties of a good cement and resembling in its general action Portland cement. It is said to be much cheaper than any cement yet used, and so far as engineering work is concerned it is employed in the manufacture of piping, slabs, tiles, conduits, etc., together with concrete for boiler and machinery foundations, and hydraulic cement. Petrifite, if powdered, will bind together into a solid stone-like mass an immense number of substances, among them being wood, paper pulp, earth material, sea-sand, powdered slate, etc. The material hitherto has been developed by a syndicate which, however, proposes to sell its rights to the public.

General News.

NEW INCORPORATIONS.

THE PEOPLE'S TELEPHONE COMPANY, Detroit, Mich., has been incorporated with a capital stock of $6000.

THE EASTERN ILLINOIS TELEPHONE COMPANY has been incorporated at Watseka, Ill., with a capital stock of $15,000. The promoters are W. H. Harry, H. W. Snow and Lee Patrick.

THE JACKSON-UNION COUNTY TELEPHONE COMPANY has been incorporated at Anna, Ill., with a capital stock of $35,000. The incorporators are W. H. Cisne, C. T. Maris and C. M. Brock.

THE JONESBORO TELEPHONE COMPANY, Little Rock, Ark., has filed articles of incorporation. The capital stock is $7500. The incorporators are E. F. Young, R. P. Martin and F. H. Jeannin.

THE EXCELSIOR SPRINGS ELECTRIC LIGHT & GAS COMPANY, Excelsior Springs, Mo., has been formed with a capital stock of $12,000. Those interested are R. L. Yeager and A. R. Strother.

THE PELHAM ELECTRIC LIGHT & POWER COMPANY OF NEW YORK CITY has been incorporated with a capital stock of $100,000. The incorporators are Charles W. Smith, John T. Boyd, Thomas F. Conville and Joseph A. Spratt.

THE CORNING CONSTRUCTION COMPANY has been formed at Corning, N. Y., to generate electricity for electric light, heat and power. The directors are Hosea A. Clark, of Corning; Thomas C. Frenyear, of Buffalo; Marc W. Comstock, Edward J. Slattery and W. A. S. Chipman.

THE CATSKILL ELECTRIC RAILWAY COMPANY, Catskill, N. Y., has been organized to construct an electric road from Catskill to Jefferson. The incorporators are William S. Robert, W. C. Courtney, William C. Wood, of Brooklyn; Daniel W. Sharp, of Catskill, and S. W. Mattison, of Newark, N. J.

THE WALTON TELEPHONE COMPANY, Walton, N. Y., has been incorporated for the purpose of operating a telephone line in Walton and the connecting villages of Delhi and Deposit. The capital stock is $4000. The incorporators are S. P. Wilber, George Paine, J. R. Honeywoil, J. K. Munn and others.

TELEGRAPH AND TELEPHONE.

LAWRENCE, KAN.—The metallic telephone circuit between Kansas City and Lawrence, erected by the Kansas & Missouri Telephone Company, has been completed.

NAVASOTA, TEX.—The completion of the Navasota and Anderson telephone lines gives communication with the county capital. The line is working in first class order.

DES MOINES, IA.—The crossing of telephone wires with trolley wires recently started a fire in the telephone exchange, which resulted in the burning out of about 50 lines.

SHELBYVILLE, IND.—A telephone line between this place and Sullivan has been completed. This connection enables communication with Windsor, Findlay, Middlesworth and Duval.

DAVENPORT, IA.—Mr. J. C. Hubinger, of Keokuk, Ia., has made application to the City Council for a franchise to establish an independent and competitive telephone service in this city.

GENEVA, O.—The Jefferson & Warren Telephone Company has purchased the telephone line from East Orville to Huntsburg, and will operate the same in connection with the lines already built.

BLOOMINGTON, ILL.—The Paxton Telephone Company is making arrangements to construct a telephone line from Paxton to Roberts, *via* Melvin, providing sufficient support can be obtained.

BEARDSTOWN, ILL.—The Union Telephone Company is putting in an exchange at Rushville with a capacity of 80 instruments. When the work is done it will give a toll line between this city and Rushville.

WILLOW, MICH.—The Citizens' telephone line of Wayne and Monroe Counties is completed between Carlton and South Rockwood, including several other places on the way. Messages are repeated at South Rockwood for Detroit and Toledo.

THE CHICAGO TELEPHONE COMPANY.—The gross earnings of the Chicago Telephone Company during 1896 was $1,955,829; expenses, $1,355,624; net earnings, $600,205. During the year the capital stock was increased from $3,796,200 to $4,336,500. The earnings for the year were at the rate of 13 84 per cent. upon the increased capital.

THE CENTRAL UNION TELEPHONE COMPANY held its annual meeting in Chicago on Jan. 20. The gross earnings for 1896 were $1,327,931; expenses, $1,026,311; net revenue, 237,099; dividends paid, $66,053. The expenses for new construction amounted to about $700,000, of which $425,000 went into exchanges and $275,000 for metallic circuit toll lines.

MANHATTAN, KAN.—The telephone exchange here was put into operation in August, 1895, with 100 subscribers. The patronage has steadily grown, until at the present time there are 176 'phones connected, three of these being on a ground circuit four miles long. Another ground circuit is being put up which will have five 'phones, the line being about seven miles in length. The switch board was supplied by the Western Telephone and Supply Company. The rates are $1 a month for residences and $2 for business uses.

ELECTRIC LIGHT AND POWER.

MARIETTA, O.—A resolution was adopted calling for an election to be held Feb. 8, to decide upon issuing $55,000 in bonds to build an additional city electrical plant and to erect a new high school building.

MORRISTOWN, N. J.—The special Subway Committee of the Board of Aldermen has under consideration and will probably present, at the next meeting of the Board, an ordinance providing for the placing of wires in Morristown underground.

SCRANTON, PA.—Fire on the morning of Jan. 31 damaged the large plant of the Scranton (Pa.) Illuminating, Heat & Power Company. Half of the town was left in darkness, and other inconveniences resulted from the lack of current. The loss is placed at $50,000.

PRINCETON, KY.—Messrs. Blake Brothers of this place are putting in an electric light plant for Boyce & Eddins and the East Tennessee Telephone Company is putting in a new telephone system. Both these improvements will be in working order by March 1, 1897.

ASHLAND, KY.—Engineers employed by the New York syndicate controlling the Morgan County coal deposits are looking into the possibilities of using the water-power of the Licking River in the operation of an electric station, the idea being to use electric mining apparatus in all the mines.

SALISBURY, MD.—Capitalists from Philadelphia have been here looking over the territory preparatory to putting in an electric light plant. The projectors say they propose to install a complete plant, with all the modern improvements, and will probably furnish power for manufacturing purposes.

NEW ORLEANS, LA.—The Louisiana Electric Light Company on Jan. 21 was taken out of the hands of the receivers and placed in charge of the Edison Electric Light Company, who will conduct the business on behalf of the American Loan & Trust Company. The latter concern bought the plant at a recent sale.

PHILADELPHIA, PA.—The annual meeting of the Edison Electric Light Company of Philadelphia, which is controlled by the Heat, Light & Power Company, was held on Jan. 27. The annual report shows an increase in the net earnings of $35,000; an increase in the number of lamps in use of 18,575, and an increase of 16,471 feet in the length of the underground conduit.

JOLIET, ILL.—On January 25, fire destroyed the plant of the Economy Light & Power Company. The loss is estimated at $125,00; the insurance amounts to $50,000. It is supposed that the fire was started by a coal oil stove which was used to prevent the pumps from freezing. The company operated 462 arc lights and 3700 incandescents, the arcs being operated on the Thomson-Houston alternating system. The plant will be rebuilt at once.

EAU CLAIRE, WIS.—Arthur Huey, of Minneapolis, and David Douglas, of Eau Claire, representing the syndicate which has asked the City Council for a franchise, state that they expect to develop about 2500 horse-power on the Eau Claire River by putting in a masonry dam, 32 feet high, in a narrow gorge five miles from the city, and convey the water in a large steel pipe to be laid along the bank of the river to a power-house with turbine water-wheels and dynamos to furnish electric power for factories.

WASHINGTON, D. C.—In the Government Printing Office there are now in daily use 117 direct-connected and 10 belted motors varying in size from one-sixth to 30 horse-power, making a total of 383 horse-power in electric motors. In addition to this is a 30-hp motor used in connection with a Sprague elevator, making a total of 413 horse-power of electric motors thus far installed in the office. According to the report of the chief electrician of the plant, during the past year there were no shut downs or any delay in work during the installations of the various motors, and the best results have been experienced by their use.

ST. JOSEPH, MO.—The following proposition is before the Council: The St. Joseph Railway, Light, Heat & Power Company will offer to furnish arc lights of 2000 candle-power each for $85 per light per year, lights to burn all night and every night instead of a moonlight schedule. If at any time the

city should require more than 40 lights, the company will furnish them for $75 per light per year. Additional lights are to be placed in any part of the city designated by the Common Council, at the expense of the St. Joseph Railway, Light, Heat & Power Co pany. The electric light company further proposes to purchase the present lighting plant and pay $60,000 for the same, payments to be made in installments of $3000 each year.

The Electric Railway.

NEW HAVEN, CONN.—An electric road from East Haven Green to Mansfield and Cosey Beach is talked of.

MARION, IND.—The Marion City Railway Company proposes to extend ts lines to Fairmount in the Spring.

NEW HAVEN, CONN.—A trolley line on Block Island, connecting the old and new harbors, is projected. It will be a Summer line.

EASTPORT, ME.—An act has been presented to the Maine Legislature for the incorporation of the Eastport Street Railway Company.

PINEHURST, N. C.—Mr. Tufts will ask the Legislature to charter his electric railway from Pinehurst to Southern Pines. It will be five miles long.

SANFORD, ME.—The Mousam River Electric Road is soon to pass into the control of a syndicate of Boston capitalists who will extend the road to Kennebunk and Cape Porpoise.

PORTLAND, ME.—The Portland Railroad Company has asked permission to increase its capital stock from $500,000 to $1,000,000, and to extend its road from Westbrook to Gorham.

AVONDALE, PA —The Avondale and West Nanticoke people again intend sending a petition to the Traction Company, asking it to extend its road from Plymouth to Hemlock Creek.

ROCKAWAY, N. J.—Officials of the Central Railroad of New Jersey have uuder advisement the equipping of the High Bridge branch of that road from Rockaway to Port Oram with the trolley.

MIDDLEBORO, MASS.—It is stated that work will be commenced upon the Middleboro & Lakeville Street Railway, in the early Spring, and that a portion of it will be in operation before the close of Summer.

HIGHLAND PARK, ILL.—The Highland Park Council has passed the ordinance granting a 21-year franchise to the Bluff City Electric Street Railway Company, giving it permission to construct and operate a system of street railway lines on certain streets of that city.

PHILADELPHIA, PA.—William Davis has sold his hotel property at Newton Square to the Philadelphia & West Chester Electric Railway Company. This opens the way for the line to Castle Rock, which is to be made a resort, and it is probable that the line will be extended to West Chester.

LONG BRANCH, N. J.—The Atlantic Highlands, Red Bank & Long Branch Electric Railway Company is negotiating for the purchase of mill property at Eatontown, with the intention of converting it into a power plant for supplying motive power for its trolley lines. The company intends to build a trolley line between Asbury Park and Freehold, in addition to the road it now operates between Long Branch and Bedford.

REYNOLDSVILLE, PA.—There has been filed at the State Department the joint agreement of consolidation and merger between the Reynoldsville & Falls Creek Railroad Company, forming a corporation under the name of the Reynoldsville & Falls Creek Railroad Company. The concern is capitalized at $330,000. Lucius W. Robinson, of Punxsutawney, is president. The road will run from Reynoldsville to London Mines, a distance of 11 miles.

Legal Note.

DECISION IN THE THREE MOTOR ELECTRIC CRANE SUIT.—A decision against the complainants was rendered on January 22, 1897, by Judge Acheson, of the United States Circuit Court for the District of New Jersey, in this suit involving apparently the control of the modern three motor electric crane. The suit was brought by the Shaw Electric Crane Company, of Muskegon, Mich., against Henry R. Worthington, Incorporated, users of a three motor electric crane manufactured by the Morgan Engineering Company, who actually defended the action. Frederick H. Betts and Francis Forbes, of New York City, were complainant's counsel and John R. Bennet, also of New York, acted for the defendant. The patent owned by the complainants, on which this suit was based, is a patent for an electric crane issued to Alton J. Shaw, deceased, of Milwaukee, Wis., on June 17, 1890, numbered 430,487. This patent broadly covers the use of three separate motors to perform the different operations necessary in nearly all so-called traveling cranes, *viz.*: the propulsion of the bridge, the movement of the trolley on the bridge and the rotation of the hoisting drum on the trolley, on which the hoisting cable is wound. Each of these operations are reversible.

Quoting from the patent specifications, the inventor states: "The improvements consist in the combination, with the bridge, the trolley and the hoisting drum, of independent electric motors controllable from a common point. . . . It is often necessary or desirable that three operations be simultaneously carried on—namely, a travel of the bridge upon the supporting rails, a traverse of the trolley or car upon the bridge and a raising or lowering of the chain or cable which passes about or winds upon the hoisting pulley or drum. . . . To attain this end various plans have been devised." Following this several methods are described, including polygonal shaft, hydraulic and endless chain and cable transmission devices, intended and previously used to produce the above results. The objections to these methods are stated and the specification continues with: "So far as I am aware no plan has heretofore been proposed whereby shifting clutches, gripping devices and reversing gear generally might be wholly dispensed with, but by the employment of reversible electric motors and the adaptation of the motor and the crane each to the other, I am enabled to attain this important result."

The advantages due to the fact that the energy supplied to each motor is in proportion to the work done by it and also the rapidity of the power transmission are stated. The drawings are then described. These show a crane and details thereof equipped in the manner described. A diagrammatic arrangement of a motor and regulator is also shown. This description concludes with: "A separate switch will be provided for each motor, and all will be arranged within the attendant's cab." . . .

The patent has 10 claims. Infringement was charged on the first, second and tenth claims, which read as follows:

"1. In combination with a supporting track, a bridge mounted and movable thereon, a trolley or car mounted and movable upon the bridge, a hoisting drum or pulley carried by the trolley, and three independent electric motors each in communication with a source of electricity, one of said motors being carried by and serving to propel the bridge, and the other two being carried by the trolley and serving, respectively, to propel the trolley and to actuate the drum or pulley.

"2. In combination with a supporting track, a bridge mounted and movable thereon, a trolley or car movable upon the bridge, a hoisting drum or pulley carried by the trolley, an electric motor carried by the bridge and serving to impart motion thereto, a second electric motor carried by the trolley and serving to propel the same, and a third electric motor also carried by the trolley and serving to actuate the hoisting drum or pulley, the several motors being wholly independent of one another and all capable of reversal, whereby the attendant is enabled to cause a travel of the bridge in either direction, a movement of the car or trolley forward or backward, and a raising or lowering of the hoisting chain or cable simultaneously or at different times, and to perform each of said operations regardless of the others. . . .

"10. In a traveling crane, the combination of a bridge, a trolley movable thereon, a hoisting drum or pulley carried by said car, three separate motors, one carried by and serving to propel the bridge, another carried by and serving to propel the trolley, and the third also carried by the trolley and serving to actuate the drum or pulley, said motors being independently supplied with power from a source wholly outside the traveling crane."

The examination of witnesses by both sides and other necessary legal work extended over a period of nearly two years. Among the complainant's witnesses were: Arthur S. Browne, Cyrus F. Brackett, Francis Forbes, Charles A. Moore and Prof. Robert H. Thurston. Some of the defendant's witnesses were: Edward M. Bentley, Cyrus G. Force, John R. Morgan, T. R. Morgan, Sr., W. H. Morgan, E. W. Rice, Frank J. Sprague and Elihu Thomson.

The defense argued that the patent in suit did not embody invention and the various elements of the combination simply involved aggregation, as the patent states that all three motors operate independently. The defence of lack of invention was sustained, but the last mentioned defence was not considered.

The judge's opinion, which is practically a summing up of the entire testimony, shows the following:

"The style of crane described and illustrated by this patent and here involved, is none other than the ordinary overhead traveling crane—an old and well-known style of crane."

Prior to 1888, the year when Shaw filed his application, self-contained steam power cranes were used.

"The United States patent of 1875 to Force and the English patent of 1878 to Newton show each a self-contained, steam power overhead traveling crane in which the three different movements of the parts . . . are affected simultaneously or separately as desired by three independent engines . . . operated by the same attendant standing in one position."

"Anterior to Shaw's alleged invention, the electric motor had come into successful practical use in every kind of service." . . . "The peculiar advantages of the electric motor. . . . were well understood. The electric motor had already been applied to the practical working of cranes."

In considering these facts, the opinion states; "the mere application of electric motors to traveling cranes certainly did not involve invention, even had Shaw been the first to operate cranes electrically. . . the employment of three independent electric motors controlled from a common point for the movement of the several parts of the old overhead traveling crane is not to be accounted as an act of invention."

"The difference between the cranes of Force and Newton and the crane of the patent in suit are simply such as would naturally be made in changing the motive power." . . .

The bill of the complainants was dismissed with costs.

It appears from the evidence that Shaw was the first, however, to build and develop a three-motor electric crane. At the time this was accomplished by Shaw, a step in advance of previously existing methods was made, the value of which is shown by the fact that others were working in the same direction immediately after. The combination of three separate motors to operate a traveling crane may not have been invention, but it certainly produced a superior machine. An abstract from the testimony may be quoted to substantiate this.

Mr. Alton J. Shaw, after whom the Shaw Electric Crane Company was named, had in operation an electric crane in the shops of the Allis Works in Milwaukee in the early Spring of 1889. The Morgan Engineering Company writing to Mr. E. P. Reynolds, of the Allis Works, under date of March 15, 1889, said:

"ALLIANCE, O., March 15, 1889.

"Messrs. E. P. Allis & Co., Edwin Reynolds, Esq., Supt., Milwaukee, Wis.

"*Dear Sir:*— . . . We have commenced our electric crane—for the last six months—but have been unable to finish it, having so much work on hand, for other parties and ourselves, but hope to get ready in about a month or six weeks from now. We will have one dynamo (motor) only. This has been here many months, and we simply want to use it to take the place of shaft; however, if we find the simplicity of the three dynamos (motors) at a future time, we may change.

"Glad to know that you are satisfied with the Sprague motors on your traveling cranes. We have ordered one of these motors to-day, to drive a lathe and straightening machine. We had written to them some time ago and their man visited us this morning.

"When my sons are out West next time, they may drop in and see your three

motors at work, and shall be obliged for any information you can give us. With best wishes,

"We are yours truly,
"MORGAN ENGINEERING COMPANY,
"*T. R. Morgan, Sr., President and Treasurer.*"

We are informed that an appeal will be taken from this decision. The Shaw Electric Crane Company also have a suit pending against Walter T. Shriver & Co., manufacturers of cranes, New York, which is ready for hearing.

PERSONAL NOTES.

MR. GEORGE W. CONOVER, of the Conover-Goe Company, Chicago, Ill., is well known to the electrical fraternity. He was for many years the buyer for the old Electrical Supply Company, and his association with this concern brought him into personal contact with the leading manufacturers of electrical and hardware specialties. The list of acquaintances thus formed has since been added to as a result of several years of activity in selling electrical supplies. It is a rare thing to find the qualities of a good buyer and good seller combined in one person, but Mr. Conover's business career seems to prove conclusively that he has the two talents strongly developed.

GEORGE W. CONOVER.

MR. D. E. GOE, of the Conover-Goe Company, Chicago, has been identified with electrical development ever since he was a mere lad, having made application for patents on sundry improvements at the early age of thirteen years. His experience covers a period of 30 years in actual work, beginning with the unpoetical occupation of scooping out telephone post-holes under the direction of the late Wiley W. Smith. He soon realized that poles could be climbed and he determined to climb up—in experience and position. He was promoted rapidly until he attained the position of State superintendent for the Southern Telephone & Telegraph Company. About this time electric lighting was claiming a large share of attention, and Mr. Goe became engaged in the work of installing isolated plants. In this work he gained a great deal of practical experience that has since been of invaluable service to him. In 1890 he was connected with the Electrical Supply Company as advertising manager, and for the past two years he has been connected with the Central Electric Company as manager of the business and at the same time looking out for the advertising.

D. E. GOE.

MR. HENRY G. ISSERTEL, of the New York office of the Walker Company, is receiving congratulations on the birth of a daughter on Jan. 29. Miss Issertel's name will be Marjorie.

Trade and Industrial Notes.

THE EAGLE ELECTRIC MANUFACTURING COMPANY, Pittsburg, Pa., is receiving many orders for its new illuminated mouthpieces.

MR. A. DE VEAU, 32 Frankfort Street, New York City, has just returned from a flying trip to Philadelphia with a very substantial contract in his inside pocket.

THE AMERICAN ELECTRIC METER COMPANY, Philadelphia, Pa., has moved its office from 1014 Betz Building to the corner of Ninth Street and Montgomery Avenue.

THE ROYAL ELECTRIC COMPANY, Peoria, Ill., has received from the Oklahoma Gas & Electric Company, Oklahoma City, O. T., an order for a 65-kw alternating-current generator.

THE LOANDO HARD-RUBBER COMPANY, Boonton, N J., is pushing its rubberized asbestos insulating material, and reports meeting with great success among the largest manufacturers of electrical apparatus in this country.

JENKINS BROS., 71 John Street, New York, manufacturers of Jenkins' standard packing and Jenkins Bros.' valves, will, on or about Feb, 15, remove their Boston store to 17 Pearl Street. The store is now under the management of Mr. J. D. Stiles.

MR. I. P. FRINK, 551 Pearl Street, New York, is equipping many store windows with his special electric cluster reflectors, lined with his composition of silver-plated corrugated glass. He reports many inquiries for these reflectors for use in schools and railway stations.

PIONEER LAMPS.—The Electric Arc Light Company, 687 Broadway, New York, informs us that it has secured the order to light the new 14-story building at the corner of Broadway and Twelfth Street. The lamps have already been installed and the building is considered one of the best lighted in the world.

THE KEYSTONE TELEPHONE COMPANY, 565 Old Avenue, Pittsburg, Pa., has just received an order to equip with Keystone telephones the entire works of the Westinghouse Air Brake Company at Wilmerding, Pa. Not only is the Keystone Company to install telephones, but the entire wiring, placing, etc., is to be executed by the company.

THE AMERICAN ELECTRIC HEATING CORPORATION, Boston, has gotten out a complete revised price list in condensed form, yet completely describing its improved products. Many improvements have been made in the past year and new items added, while prices have been reduced. Dealers should get the new list and new discounts.

THE SCHEEFFER WATTMETERS are rapidly meeting with deserved popularity at the hands of the central station manager, through the energetic efforts of the Central Electric Company, Chicago, pushing this superior instrument. The Central Electric Company has just compiled a special price-list, which will be mailed to central stations upon request.

THE RIDER-ERICCSON ENGINE COMPANY is the title of a concern just incorporated in New York State to manufacture the Rider & Ericcson hot-air pumping engines. The company has acquired the plants and property of the De Lamater Iron Works and Rider Engine Company, and will conduct at 37 Dey Street, New York, and 86 Lake Street, Chicago, the business heretofore conducted by them. Branch stores will soon be opened in Boston and Philadelphia.

THE STROWGER AUTOMATIC TELEPHONE EXCHANGE, 166-174 South Clinton Street, Chicago, reports excellent progress in its business. It has recently finished public automatic exchanges at Amsterdam, N. Y., Albion, N. Y., Coudersport, Pa. and Marysville, Kan.; interior exchanges in the new Siegel-Cooper Building, New York City, and the new City Hall, Milwaukee. The company is now building public exchanges at Augusta, Ga., and Denver, Col., the former for 400 subscribers and the latter for 2000.

THE CHICAGO FUSE WIRE & MANUFACTURING COMPANY, 153 Lake Street, Chicago, is distributing to the trade a descriptive circular and price list of tested fuse wire and links. Links of all sizes and for all uses are illustrated, the dimensions of each being given. The company is now equipping a testing laboratory with the latest approved instruments, going to a large expense for this purpose. The manager, Mr. W. R. Goodman, has had over eight years' experience in making and selling fuse wire. The company is enabled to meet demands at short notice for material, whether regular or special.

MR. HUGO REISINGER, 38 Beaver Street, New York, sole importer of "Electra" highest grade Nuernberg carbons, has secured the services of Mr. W. McCullough, who will henceforth represent Mr. Reisinger's interests in the West. Mr. McCullough for the past three years represented in the West the Canadian General Electric Company, and his numerous friends will be pleased to learn of his new connection and wish him much success. He is energetic and always keeps to the front in his business, and Mr. Reisinger has good reason to be congratulated on his success in securing the services of one so capable.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY, 917-919 Market Street, St. Louis, Mo., is making rapid strides forward, and has secured the second floor of its building, affording double the former capacity. The company has equipped its entire factory with new and improved machinery. Its new catalogue for 1897 is just from the press, and is claimed to be the largest and most complete illustrated telephone catalogue ever issued. It quotes prices on the company's entire line of manufactures, as well as containing general and valuable information. A copy of this catalogue should be in the hands of all interested in telephones and can be had for the asking.

. THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., has during the past year made a number of improvements, and reorganized its manufacturing and office arrangements. At the annual meeting of the company on Jan. 15, the report showed a profit sufficiently large to pay 3 per cent. semi-annual dividends on the common stock and 3½ per cent. on preferred stock. The company manufactures a line of pressing, punching and stamping machinery, and during last summer secured some good sized orders for machines of this class from the Chinese Government. The bicycle and electrical machinery trade also furnished a good deal of work for the concern, and a number of orders were also received from electrical establishments in France, Belgium and Austria.

TROLLEY PATENTS.—We have received from the Siemens & Halske Electric Company of America, Chicago, a letter touching the claims of owners of the underground trolley patents, of which letter the following is a copy:

To the Editor of The Electrical World:

SIR:—We have noticed from time to time both in the reading columns and advertising columns of your paper, that statements were made by certain competitors that they absolutely owned and controlled the patents covering all underground trolleys.

This statement does not refer to the Siemens trolley or contact bar, the well-known device in use all over the world, which has been described repeatedly; it makes a sliding contact with the trolley wire, making overhead construction very simple and doing away with the necessity of switches and frogs, besides making it impossible for the device to be "off the trolley."

There were also statements in the papers that certain American companies had patents on electric railway conduits and had installed what they pleased to term "The Buda-Pesth Conduit System."

It is a well-known fact that the first successful electric conduit system—the Buda-Pesth conduit system—was installed by Messrs. Siemens & Halske, Berlin, and all United States patents covering the main features of this system are owned and controlled by the Siemens & Halske Electric Company of America.

The Siemens & Halske Electric Company is prepared to furnish complete trolley stands and trolley contacts and to install complete electric conduit railway systems under the patents it owns and controls, or it is willing to license prospective customers under these patents.

We think that these facts—and facts they are—will be undoubtedly of interest to many of your readers, and we ask you kindly to mention them in the reading columns of your valuable paper.

Yours very truly,
F. B. BADT, *Secretary.*

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

BATTERY CUT-OUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

THE CASE between Manning, Maxwell & Moore, New York, representing the Shaw Electric Crane Company and the Morgan Engineering Company, Alliance, O., in the United States Circuit Court of New Jersey, known as the Shaw *vs.* Worthington case, has been decided in favor of the Morgan Engineering Company. Manning, Maxwell & Moore were represented by Francis Forbes and Frederick H. Betts, of New York City, and the Morgan Engineering Company by John R. Bennett, of New York City. This case has been a long drawn out patent litigation, covering years of time, and the Morgan Engineering Company are being highly congratulated on their victory.

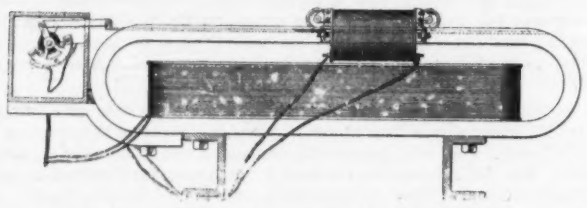
Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED JAN. 26, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

575,699. ELECTROMECHANICAL MOVEMENT; E. D. Chaplin, Cambridge, and H. G. Halloran, Boston, Mass. App. filed March 21, 1896. An electro field-magnet and a coil-armature wholly exterior to the coil of said magnet, one of which is reciprocal relatively to the other, the lines of force of the field intersecting the coils of the armature, means to produce a current in the field and armature, and means to change the direction of current of one of them, in accordance with the relative reciprocation of one to the other.

575,733. SYSTEM FOR ELECTRIC SIGNALING; W. McC. Ramsey, Allegheny, Pa. App. filed Aug. 9, 1894. In a signaling system for railways, a trolley or feed wire having a branch at each station, a line wire having a terminal switch at each station, and a return-circuit; the switches co-operating with the return and branch circuits alternately.



575,699.—Electromechanical Movement.

575,767. APPARATUS FOR DETERMINING ELECTRICAL RESISTANCES CONTAINING E. M.Fs.; C. Frolich, Charlottenburg, Germany. App. filed May 11, 1895. In a system for measuring an electrical resistance combined with an E. M. F. acting therein, the combination with a Wheatstone bridge system including the said resistance in one of its lateral branches, of means for causing variations in the current flowing through one of the diagonal branches of the said bridge system and means for measuring the ratio of the variations of the current in the two diagonal branches.

575,772. RÖNTGEN RAY TUBE; E. Thomson, Swampcott, Mass. App. filed Aug. 21, 1896. An apparatus for the generation of Röntgen rays, comprising a chamber having a Crookes vacuum and provided with a pair of concave electrodes, both of which face upon a bombarded metal piece situated in substantially the focus of their concavities.

575,777. ELECTRIC METER; W. C. Fish, Lynn, Mass. App. filed Oct. 16, 1896. In an electric meter, the combination of an armature, a field-coil therefor, recording mechanism actuated by the armature, and means for weakening the field periodically, or at intervals.

575,782. RAIL SUPPORT; W. B. Potter, Schenectady, N. Y. App. filed Aug 25, 1896. The combination in an insulating support for a third rail, of a body of insulating material carrying a metallic cap, the cap provided with lugs adapted to register with notches in the rail-flange.

575,785. CLOSED CONDUIT ELECTRICAL RAILWAY; E. W. Rice, Jr. App. filed Oct. 31, 1896. In a surface contact or closed-conduit electric railway system, an independent ground connection adjacent to the pick-up magnet contacts and adapted to protect the coils on the pick-up magnets from extraneous or leakage currents.

575,805. ELECTRICAL SIGNAL SYSTEM; F. Freeman, New York, and R. E. Slater, Montrose, N. Y. App. filed May 25, 1896. In an electric railway and signal system, adapted for use in connection with a railway track, which is divided into blocks or sections, the rails of which are insulated at the ends of said blocks or sections, the combination therewith of a signal apparatus, one of which is located at the beginning of each block or section, said apparatus being provided with a plurality of longitudinal rows of springs, which are arranged in pairs, and a shaft provided with wedges by which connection is made between the springs of each pair, said wedges and said springs being also insulated from each other, and the springs of each pair being provided with binding posts and magnets suitably mounted, and provided with an armature which is connected with a lever, which is adapted to operate in connection with said shaft, or a ratchet wheel mounted thereon, and means connected with said shaft for releasing or locking locking-tappets, or similar devices which control the signal-levers.

575,830. PRINTING TELEGRAPH; O. L. Kleber, Pittsburg, Pa. App. filed July 18, 1895. In a printing telegraphic apparatus, the combination of a type-wheel, suitable selecting discs, a pivoted finger adapted to move from one disc to the other, and thereby control rotation of said type-wheel, an electric circuit, an electromagnet in said circuit, a message transmitting key, a paper feeding device adapted to move a sheet of paper across the periphery of said type wheel, an electric switch, a printing hammer that by full, forward stroke will close said switch and thereby establish an electric circuit through said electromagnet to withdraw the pivoted finger from the selecting discs.

575,869. TELEPHONE TRANSMITTER; R. S. Barnum, Chicago, Ill. App. filed June 1, 1896. A telephone transmitter in which is combined a carbon block constituting one electrode, having a recess formed in its face, the edges of which above and below are brought into close proximity to the diaphragm, an obliquely and forwardly depending tongue, having its rear end loosely secured to said block within said recess, a diaphragm constituting the opposite electrode, and loose particles of conducting material partially surrounding said tongue and in contact therewith and with said block and diaphragm.

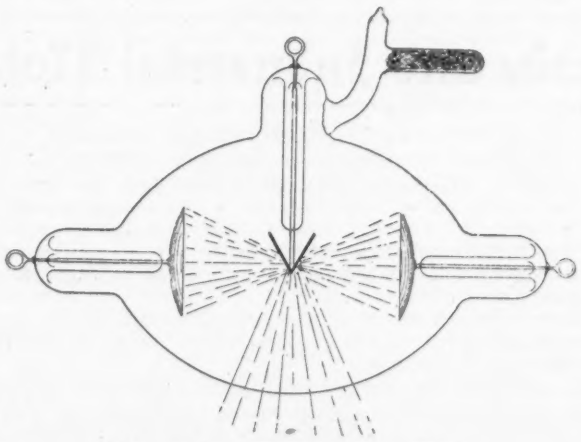
575,887. MICROPHONE; P. Hardegen, Berlin, Germany. App. filed May 28, 1896. In combination, in a microphone, the vibrating diaphragm, an electrode and a connection between the electrode and a diaphragm consisting of a flexible ring of material forming with said electrode and diaphragm a chamber for the granulated material, and serving to support the electrode on the plate to permit vibration of the same.

575,896. TELEPHONIC TRANSMITTER; M. Kotyra, London, Eng. App. filed Nov. 17, 1896. A granular telephone transmitter, comprising a vibratory helical case, carbon blocks at each end of said case, and granular microphonic material between the blocks.

575,908. SWITCH AND SIGNAL APPARATUS; J. G. Schreuder, Edgewood Park, Pa. App. filed Sept. 21, 1895. In a switch and signal apparatus, the combination of a series of electrically controlled motors for operating a series of switches and signals, or other appliances connected with a track, a series of make-and-break mechanisms controlling the circuits leading to the motors, and mechanical interlocking mechanisms arranged to interlock the switch and signal make-and-break mechanisms.

575,918. BRUSH CARRIER FOR DYNAMO-ELECTRIC MACHINES; S. S. Wheeler, New York, N. Y. App. filed May 26, 1896. In a dynamo-electric machine, the combination of rings insulated from each other and mounted on the frame of the machine at the inner end of the commutator, brush carriers on the ring extending over the commutator, and brushes mounted on the carriers.

575,952. INSULATOR; F. Hoover, Paducah, Ky. App. filed May 19, 1896. In an insulator a cross arm or timber having a circular recess or opening formed with a socket in the centre of the top, a top insulating block having a central lug adapted to fit the socket, and the bottom insulating block adapted to fit under the upper block within the circular recess or opening.



No. 575,772.—Röntgen-Ray Tube.

576,040. FUSE HOLDER; W. W. Dean, St. Louis, Mo. App. filed Sept. 19, 1896. In a fuse-holding device, the combination with a ground connection of a heavy spring adapted to effect contact therewith, a lever formed of spring-like material engaging the same at short distances from its fulcrum, the said spring-like lever constituting one of the circuit terminals, a second circuit terminal and a fuse adapted to be connected between the said terminals, thereby flexing the lever and heavy spring and normally opening the circuit to the ground.

576,053. ELECTRIC APPLIANCE FOR HORSES; L. A. Gray, Arlington, Md. App. filed Oct. 29, 1896 An apparatus consisting of a girth having a source of electrical energy and an induction coil, a circuit closer adapted to maintain an open circuit, and to be secured upon the abdomen of the horse, a primary circuit, and a secondary circuit including the circuit closer, a metal in electrical contact with the horse and an intervening position of the body.